# AVIATION WEEK

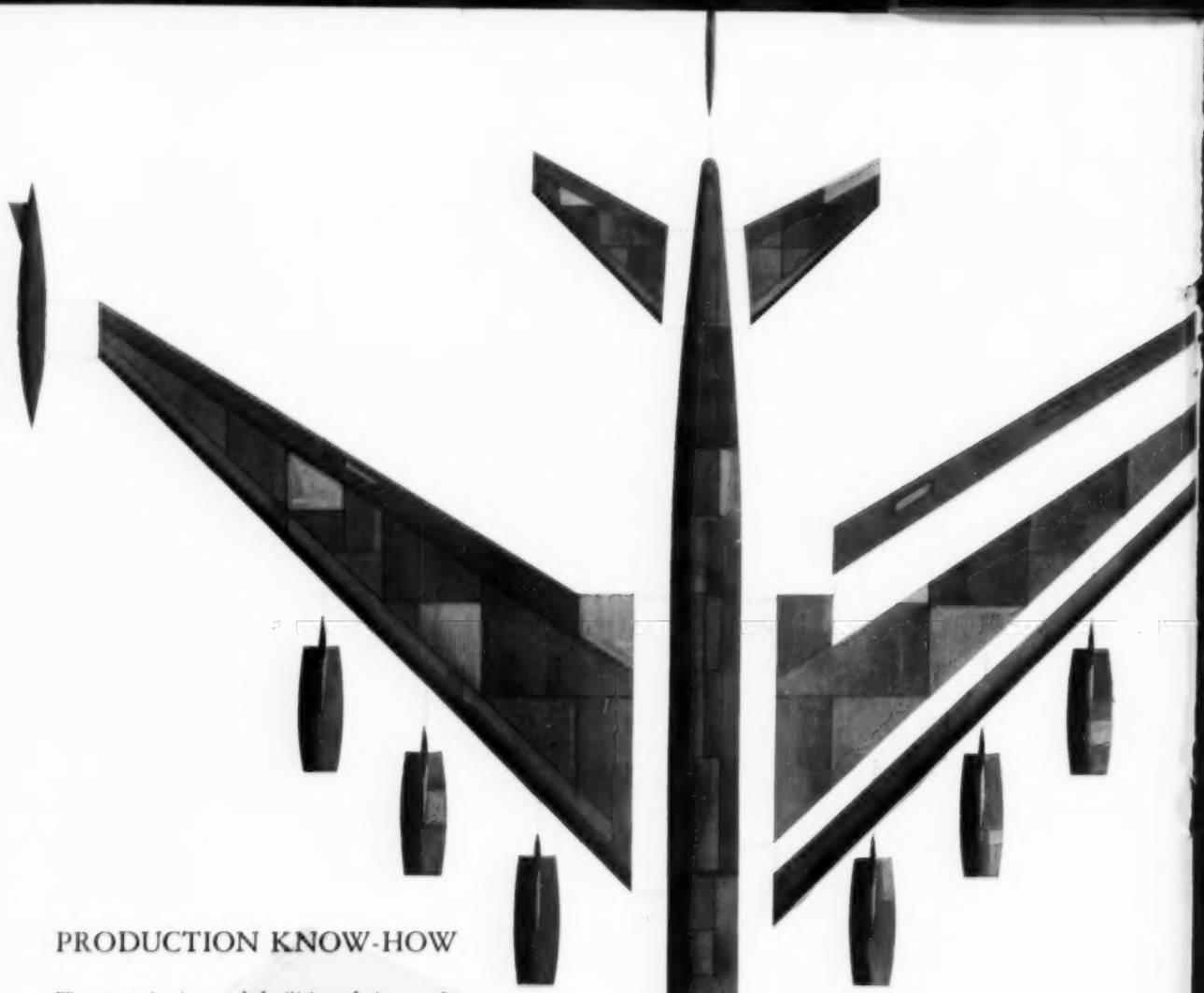
A McGRAW-HILL PUBLICATION

October 7, 1957 75 cents


## French Radio Web Bids for Use as Long Range Navaid

Lockheed Electra

## Solid Fuels Contend for Ballistic Role



## PRODUCTION KNOW-HOW

The organization and facilities of the newly streamlined Rheem Aircraft Division are geared to produce aircraft and missile airframe assemblies in high production quantity. New and modern operational concepts are being constantly applied to the basic talents and facilities available at Rheem Aircraft Division to assure the aircraft, propulsion, and ordnance industries of an on-schedule, high quality, low cost producer. Your letter of inquiry will receive prompt attention from our Marketing Department. *Rheem has manufactured more than 10,000 major aircraft assemblies since 1951.*

**RHEEM MANUFACTURING CO. / AIRCRAFT DIVISION**
*11711 woodruff avenue, downey, california*

Powerplant components . . . explosive ordnance system development . . . airframe and missile components.

The research and development activity at Rheem is engaged in the conception, evaluation, and design of drone and small missile systems and explosive and ordnance products.

Engineers: Join the 600 Rheem engineers in challenging technical work. Send resume to Personnel Manager, Aircraft Division, Rheem Mfg. Co. All inquiries held strictly confidential.

specification:
maximum
dependability

*every fighter, every bomber, every transport is Hydro-Aire equipped.*




McDonnell F-101 Voodoo

HYTROL is Standard Equipment on the F-101

## hytrol

When the cost of failure is too high—when maximum dependability is the most important part of the specification—the answer is HYTROL.

Super-sonic Fighters come in too fast for human reactions to get a "feel" for the braking action. Blowouts, flat spotting, and excessive tire wear are the result.

- The answer is HYTROL.
- No more blow-outs due to skidding.
- 30% more tire wear.
- Safety that pays off in dollars.
- Safety that can't be measured in dollars.
- Maximum protection against overshooting, swinging, or late take-off rejections.
- Maximum protection against ice, rain, slush, or snow.

HYTROL—the accepted Anti-Skid Braking System is standard equipment on the B-47, B-52, A3D, RB-66, RF-84F, F-100, C-130, QF-80 and has been proved on more than 50 different types of aircraft.



HYDRO-AIRE

3000 WINONA AVE., BURBANK, CALIF.

*the aviation subsidiary of* CRANE

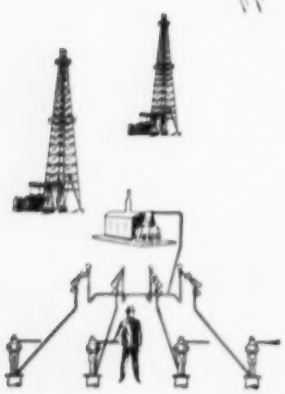
# SARGENT

HYDRAULIC
PNEUMATIC
MECHANICAL
ELECTRONIC

# SYSTEMS OF FORCE CONTROL

Sargent Systems of force control are backed by more than 37 years of experience building precision equipment to meet the increasingly high requirements of the aircraft, guided missile, petroleum, gear and machine tool industries.

If your application of force control deals with aviation, marine, surface or subsurface movement, we invite you to send your requirements for the Sargent design, qualification and manufacturing proposal.



*"GOOD WILL" is the disposition of the pleased customer to return to the place where he has been well treated.*
*– U.S. Supreme Court*

*Standard of Excellence* — *Since 1920*

Sargent offers exceptional opportunities to engineers interested in design, development, qualification testing and manufacture of advanced forced control systems. Send your resume immediately (in confidence) to Chief Engineer.

Sargent
QUALITY BUILDS GOOD WILL

**ENGINEERING CORPORATION**
MAIN OFFICE & PLANT • 2533 E. FIFTY-SIXTH ST.
HUNTINGTON PARK, CALIF.

## AVIATION CALENDAR

**Oct. 7-9**—13th Annual National Electronics Conference, Hotel Sherman, Chicago, Ill.

**Oct. 7-9**—Fourth Annual Lubrication Conference, sponsored by American Society of Lubrication Engineers and American Society of Mechanical Engineers, Royal York Hotel, Toronto, Canada.

**Oct. 7-10**—Triennial Inspection, Lewis Flight Propulsion Laboratory, Cleveland.

**Oct. 7-12**—Eighth Annual Congress, International Astronautical Federation, Barcelona, Spain. For details write: IAF, 35 Lowell Rd., Concord, Mass.

**Oct. 8**—Tenth Annual Airport Development and Operations Conference, Onondaga Hotel, Syracuse, N. Y.

**Oct. 9-11**—National Fall Convention, Society for Experimental Stress Analysis, El Cortes Hotel, San Diego, Calif.

**Oct. 10-11**—National Noise Abatement Symposium, Sherman Hotel, Chicago, Ill.

**Oct. 16**—Constant Speed Drive Development, AIEE Engineers Club, Philadelphia, Pa.

**Oct. 16-18**—Conference on Computers in Control, American Institute of Electrical Engineers, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

**Oct. 16-18**—1957 IRE Canadian Convention, Automotive Building, Exhibition Park, Toronto, Ont., Canada.

**Oct. 17-18**—13th Annual Convention, The Magnesium Assn., Biltmore Hotel, N. Y.

**Oct. 17-18**—National Conference on Industrial Hydraulics (including use in airline systems), Hotel Sherman, Chicago.

**Oct. 18**—Some Aspects of the National Guided Missile Program, Vice Adm. John S. Sides, Dinner Meeting, American Rocket Society and Institute of the Aeronautical Sciences, Sheraton-McAlpin Hotel, N. Y. C.

**Oct. 20-22**—American Helicopter Society, Fourth Annual Western Forum, Hotel Statler, St. Louis, Mo.

**Oct. 21-22**—Canadian Aeronautical Institute—Institute of the Aeronautical Sciences Meeting, Montreal, Canada.

**Oct. 21-23**—Conference on New Develop-

*(Continued on page 6)*

AVIATION WEEK • OCTOBER 7, 1957

Vol. 67, No. 14

Published weekly with an additional issue in December by McGraw-Hill Publishing Company. James H. McGraw (1860-1948), Founder. Executive, Editorial, Advertising and Subscription offices: **McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Publication Offices, 99-129 North Broadway, Albany 1, N. Y. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice President, Publication Division; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator.

**Subscriptions are solicited only from persons who have a commercial or professional interest in aviation. Position and company connection must be indicated on subscription order.**

Single copies 75¢. Subscription rates—United States and possessions, $7 a year. Canada $8 a year.

Second class mail privileges authorized at Albany 1, N. Y. Printed in U. S. A. Copyright 1957 by McGraw-Hill Publishing Co., Inc. All rights reserved. Cable Address: "McGraw-Hill New York." Publications combined with AVIATION WEEK are AVIATION, AVIATION NEWS, AIR TRANSPORT, AERONAUTICAL ENGINEERING and AIRCRAFT JOURNAL. All rights to these names are reserved by McGraw-Hill Publishing Co.

Subscription: Address correspondence and change of address to Subscription Manager, Aviation Week, 330 West 42nd Street, New York 36, N. Y. Subscribers should give old as well as new address, including postal zone number, when changing address. Enclose recent address label if possible. Allow one month for change to become effective.

**Postmaster: Please send form 3579 to Aviation Week, 330 West 42nd Street, New York 36, N. Y.**

**TRANS-SONICS**

reg. T. M.

PRECISION TRANSDUCERS

for measurement and control of

- **TEMPERATURE**
  −400F to +2000F
- **PRESSURE**
  0-5 to 0-5000 psi.

to meet strictest requirements of

- **TELEMETRY**
- **MISSILE RESEARCH**
- **AIRCRAFT CONTROL**

an example of

**TRANS-SONICS** ADVANCED INSTRUMENTATION

Type 75 PRESSURE POTENTIOMETERS

PRESSURE POTENTIOMETERS, Type 75, are precision linear pressure measuring instruments designed to withstand the severe physical conditions of missile and aircraft flight. Absolute, gauge, or differential pressures up to 5000 psi can be measured to an accuracy of ±1% of full scale with a 0.3% repeatibility. Operating temperatures range from −65F to +160F. Ultrapoise construction allows instrument to withstand 30g shock in any direction, 10g vibration to 200 cps, 25g to 2000 cps. Up to 75 volts full-scale output. Entire operating mechanism of absolute pressure instrument is hermetically sealed from external environment. Calibration Certificate giving precise 5-point pressure calibration supplied with each unit. Most pressure ranges available from stock. Send for new Technical Bulletin 75.

**TRANS-SONICS**
INCORPORATED
Burlington, Massachusetts

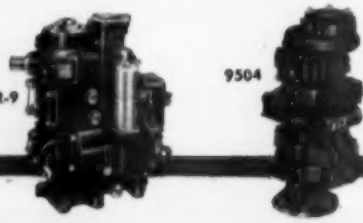
FROM AN ORIGINAL PAINTING FOR CECO BY R. T. HANDVILLE

Contributing . . .
to superb performance

Grumman's F11F-1 Tiger is powered by a Wright J-65 turbojet with *main fuel pump* engineered and built by Chandler-Evans.

Products, too, are "known by the company they keep", and CECO is proud to be airborne with many of the latest and finest military and commercial aircraft.

**Typical CECO fuel system components:** AR-9 Afterburner Fuel Control (for new, larger jets) maintains fuel flow at point value accuracies heretofore impossible; Model 9504 Fuel Pump, by-pass equipped, three-element pump, supplies fuel at predetermined pressures and quantities to both main and afterburner fuel controls.




CECO
SYSTEMS / CONTROLS

CHANDLER-EVANS
WEST HARTFORD 1, CONNECTICUT

*Write to Dept. 5C for an informative folder on CECO's new* SMALL ENGINE FUEL CONTROLS, *or for folders on:* AFTERBURNER FUEL CONTROLS; AIRCRAFT PUMPS; UNITIZED FUEL CONTROL SYSTEMS.

## AVIATION CALENDAR

(*Continued from page 5*)

ments in the Field of Power, American Society of Mechanical Engineers, Americus Hotel, Allentown, Pa.

**Oct. 21-25**—45th National Safety Congress, Conrad Hilton Hotel, Chicago.

**Oct. 22**—Third World Conference for Aviation, month-long meeting on tariffs, cargo, etc., Sao Paulo, Brazil.

**Oct. 24-25**—Fourteenth Annual Display, Aircraft Electrical Equipment, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles.

**Oct. 24-25**—Computer Applications Symposium, Morrison Hotel, Chicago; sponsored by Armour Research Foundation of Illinois Institute of Technology.

**Oct. 28-29**—Third Annual Meeting, Association of the U. S. Army, Sheraton-Park Hotel, Washington, D. C.

**Oct. 28-29**—First National Conference on Applied Meteorology, Hotel Statler, Hartford, Conn.

**Oct. 28-30**—Annual East Coast Conference on Aeronautical and Navigational Electronics, Fifth Regiment Armory, Baltimore, Md.

**Oct. 28-31**—Second Winter Meeting, American Nuclear Society, Henry Hudson Hotel, New York.

**Oct. 28-31**—National Industrial Packaging & Handling Exposition, Atlantic City Convention Hall, N. J.

**Oct. 30-Nov. 1**—Annual Meeting, Air Traffic Control Assn., CAA Technical Development Center, Indianapolis, Ind.

**Oct. 30**—Aviation Electrical Equipment Display, U. S. Grant Hotel, San Diego.

**Oct. 31-Nov. 1**—Fourth Annual Meeting, Professional Group on Nuclear Science, Henry Hudson Hotel, New York.

**Nov. 2-8**—Second World Metallurgical Congress & 39th National Metal Exposition & Congress, Palmer House, Hotel Sherman and International Amphitheatre, Chicago.

**Nov. 4-8**—Fourth Institute on Electronics in Management (automatic data processing system), The American University, 1901 F St., Washington 6, D. C.

**Nov. 5-7**—Joint Military-Industry Guided Missile, Reliability Symposium (limited to those with Secret security clearance), Naval Air Missile Test Center, Pt. Mugu, Calif.

**Nov. 11**—Plastics for Airborne Electronics, Regional Technical Conference, Society of Plastics Engineers, Hotel Ambassador, Los Angeles, Calif.

**Nov. 11-15**—1957 International Air Safety Seminar, Flight Safety Foundation, Palo Alto, Calif. FSF-Aviation Week Safety Awards Dinner, Nov. 14. For details write FSF, 468 Fourth Ave., N. Y. C.

**Nov. 11-13**—Third IRE Instrumentation Conference and Exhibit (Data Handling), Atlanta-Biltmore Hotel, Ga.

**Nov. 12-13**—Seventh Aircraft Hydraulics Conference, Park Shelton Hotel, Detroit, sponsored by Vickers Inc. (invitation only).

**Nov. 13-15**—18th Annual Convention, National Aviation Trades Assn., Hotel Adolphus, Dallas.

**Nov. 18-29**—Technical Conference, International Air Transport Assn., Miami, Fla.

# MODERN STORK *to deliver* MULTITORK®

# NEW!

**THIS MONTH** Briles' new Bell 47-J "Ranger" helicopter will leave El Segundo, California on a nationwide tour. The Purpose: to bring to the aircraft industry the great news about MULTITORK, the revolutionary new recess for high strength flush-head fasteners. MULTITORK combines *maximum simplicity* with *optimum efficiency* into a streamlined recess of superior qualities.

**GREATER TORQUE:** Multitork's torsion strength is superior to that of existing designs and more than doubles present specification standards. Reverse torsion strength is exactly equal to drive strength.

**FATIGUE STRENGTH:** Repeated testing has proven that the fatigue strength of bolts furnished with MULTITORK recess is improved up to 50%. Fatigue failure occurs in the threads, not in the head.

**INSTALLATION & MAINTENANCE:** MULTITORK'S superior strength characteristics serve to reduce installation and maintenance costs by reducing distortion and breakage of both fasteners and drivers. Inventories therefore may be reduced. *The simplicity* of the MULTITORK design allows easy removal of airfoil smoothing compound during maintenance. *The uniqueness* of design eliminates damaged bolts and drivers when the wrong style or size driver is used.

**COST:** Added to the strength, precision and uniformity achieved by cold-heading are reduced costs gained through higher production. Multitork is cold headed; no machining is performed.

**Simple and efficient in an age of the complex, MULTITORK is the recess specifically engineered for the multi-mach speeds of future aircraft and missiles.**

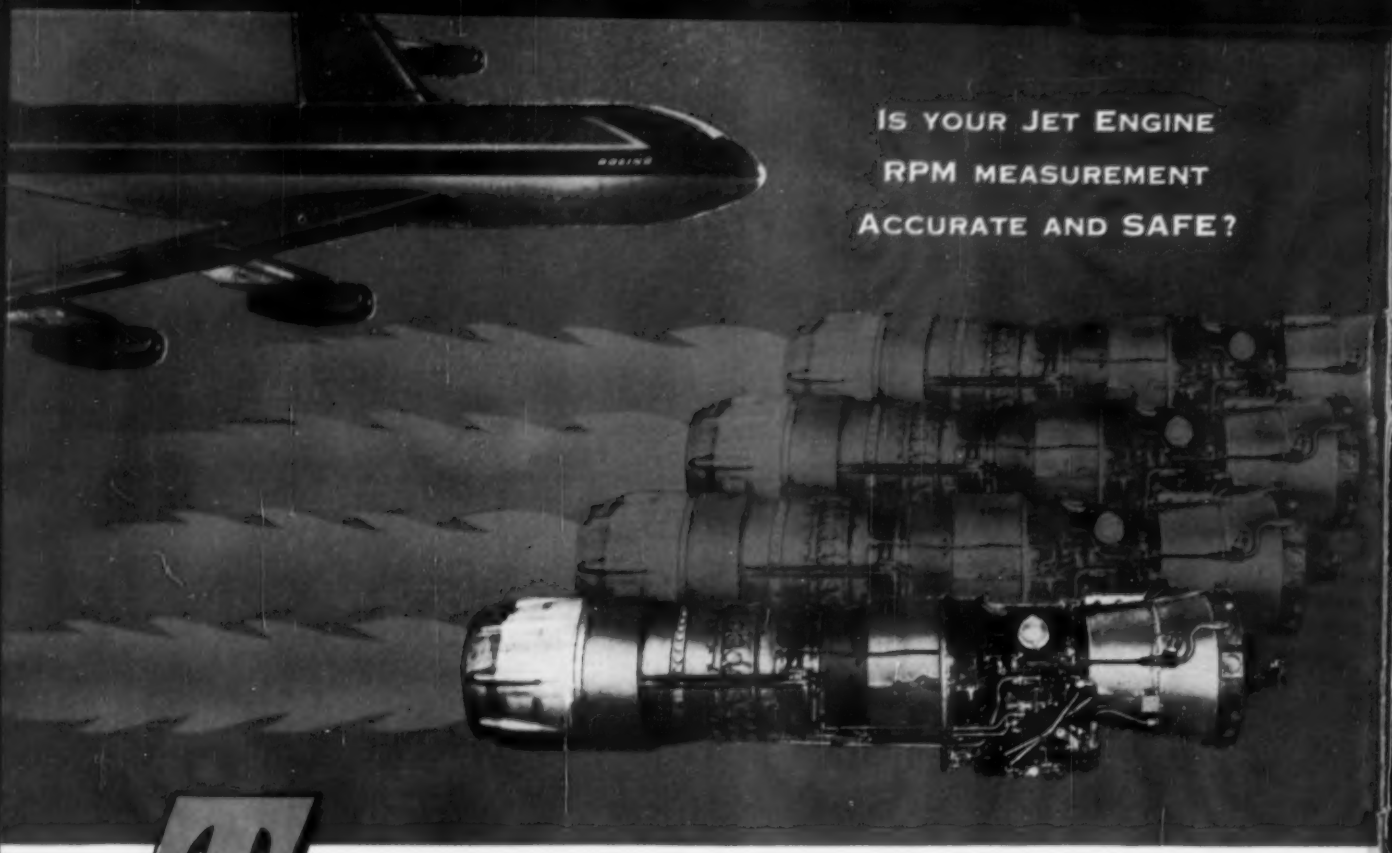
® MULTITORK — Registered Trademark

**BRILES MANUFACTURING**

1419 EAST GRAND AVENUE — EL SEGUNDO, CALIFORNIA

MANUFACTURERS OF AIRCRAFT PARTS

# BRILES MFG.




# TAKCAL®

**READS JET ENGINE SPEED to GUARANTEED ACCURACY of 10 RPM in 10,000 RPM (±0.1%)**

The inter-relation of RPM to efficiency and thrust in jet engines is fundamental. Proper adjustments for maximum thrust, maximum engine life and maximum safety of operation can be made only upon accuracy of instrumentation. The TAKCAL tests to guarantee that accuracy.

The new B & H TAKCAL incorporates a refinement of the frequency meter principle. It operates in the low (0 to 1000 cps) range, reading the frequency of the tachometer generator on a scale calibrated in percent RPM corresponding to the engine's RPM. It reads engine speed while the engine is running with a guaranteed accuracy of ±0.1% in the range of 0 to 110% RPM. Additionally, the TAKCAL circuit can be used to trouble-shoot and isolate errors in the aircraft tachometer system, with the circuit and tachometer paralleled to obtain simultaneous reading.

The TAKCAL's component parts are identical with those used in the J-Model JETCAL Analyzer. They are here assembled as a separate unit tester and for use with all earlier models of the JETCAL Tester.

The TAKCAL operates accurately in all ambient temperatures from –40°F. to 140°F. Low in cost for an instrument of such extreme accuracy, it is adaptable to application in many other fields.

*For full information write or wire . . .*

CHECKS TACHOMETER
"SYSTEM" ACCURACY.
ADAPTS TO ANY FREQUENCY PROBLEM!
Explosion-proof TAKCAL for special applications. Measures 200 to 7500 RPM, direct reading, with ±0.1% accuracy.

**B & H INSTRUMENT CO., INC.**

*3479 West Vickery Blvd. • Fort Worth 7, Texas*

**B & H makes the *JETCAL*® Analyzer and *TEMPCAL*® Tester**

***Sales-Engineering Offices:***

VALLEY STREAM, N. Y.; 108 So. Franklin, LO 1-9220 • DAYTON, OHIO; 209 Commercial Bldg., MI 4563 • EL SEGUNDO, CAL.; 427 E. Grand Ave., EA 2-1644

available soon...

# HYFEN

## a big step toward automation of wiring harnesses

**Crimped pins and sockets snap-locked in plug or receptacle. Individual circuit removal or gang disconnect.**

Hyfen ends the need for time consuming solder operations — and the high rejection rate inherent with solder. Pins and sockets are speedily crimped on wire ends by automatic installation tooling — or where more convenient, by bench or hand tools. Dies control and provide a uniform depth of indent which can be inspected by depth micrometer assuring absolute unvarying reliability. Crimping may be done before or after harness is in place.

Hyfen meets or exceeds MIL specifications for voltage drop, dielectric strength, contact engaging force, and contact retention force. It provides high corrosion resistance since there are no fluxes or dissimilar metals involved. Floating contacts in both plug and receptacle make for uniform mating and disconnecting force by the alignment flexibility provided.

Hyfen principle is not limited as to size, shape of plug and receptacle nor to number or size of connections. Wire for bulletin.

Burndy, Norwalk, Connect.—Scarboro, Canada

# "APPROACH" makes a BIG DIFFERENCE!

**The Parker "SYSTEM APPROACH"** to hydraulic and fluid problems can make a big difference in the performance and efficiency of your hydraulic or fuel system, too.

This "system approach" means that every component will be designed solely for that specific system, so that the whole will do the required job—*better.*

Parker's "system approach" can save you much precious lead time and many engineering hours—with full responsibility for performance.

Why not ask us about it, now?

The Parker Team provides specialized viewpoints to get the right answers. It's the first step in the "systems approach" . . . gives a Parker customer the plus value of leadership in experience, for today's *AND TOMORROW'S* fluid and hydraulic problems.

check valves hydraulic valves fuel valves accumulators

**Parker**

**Hydraulic and fluid system components**

**Parker Aircraft Co., Los Angeles 45, Calif. • Cleveland 12, Ohio**

(Subsidiary of The Parker Appliance Company)

THE MARK OF QUALITY

BARBER COLMAN

# Aircraft Controls

**BARBER-COLMAN SYSTEMS FOR DC-8**

Components include magnetic amplifier-type control boxes, sensing elements, temperature selectors, and actuators for the mixing valve, emergency valve, and heat exchanger flap . . . engineered for 115-volt, 400-cycle, a-c operation.

CONTROL BOX

ROTARY ACTUATOR

## Douglas selects Barber-Colman temperature control systems for DC-8

As the DC-8 takes to the air, passengers and crew will enjoy a new standard of comfort aloft. Among its many refinements, this swift airliner will incorporate advanced Barber-Colman temperature control systems in both the main cabin and flight compartment. Powered by the craft's 400-cycle a-c supply, these control systems are the result of Douglas and Barber-Colman engineering teamwork to assure constantly accurate air conditioning under all flight conditions. For help on your control projects, consult the Barber-Colman engineering sales office nearest you: Los Angeles, Seattle, New York, Fort Worth, Baltimore, Montreal.

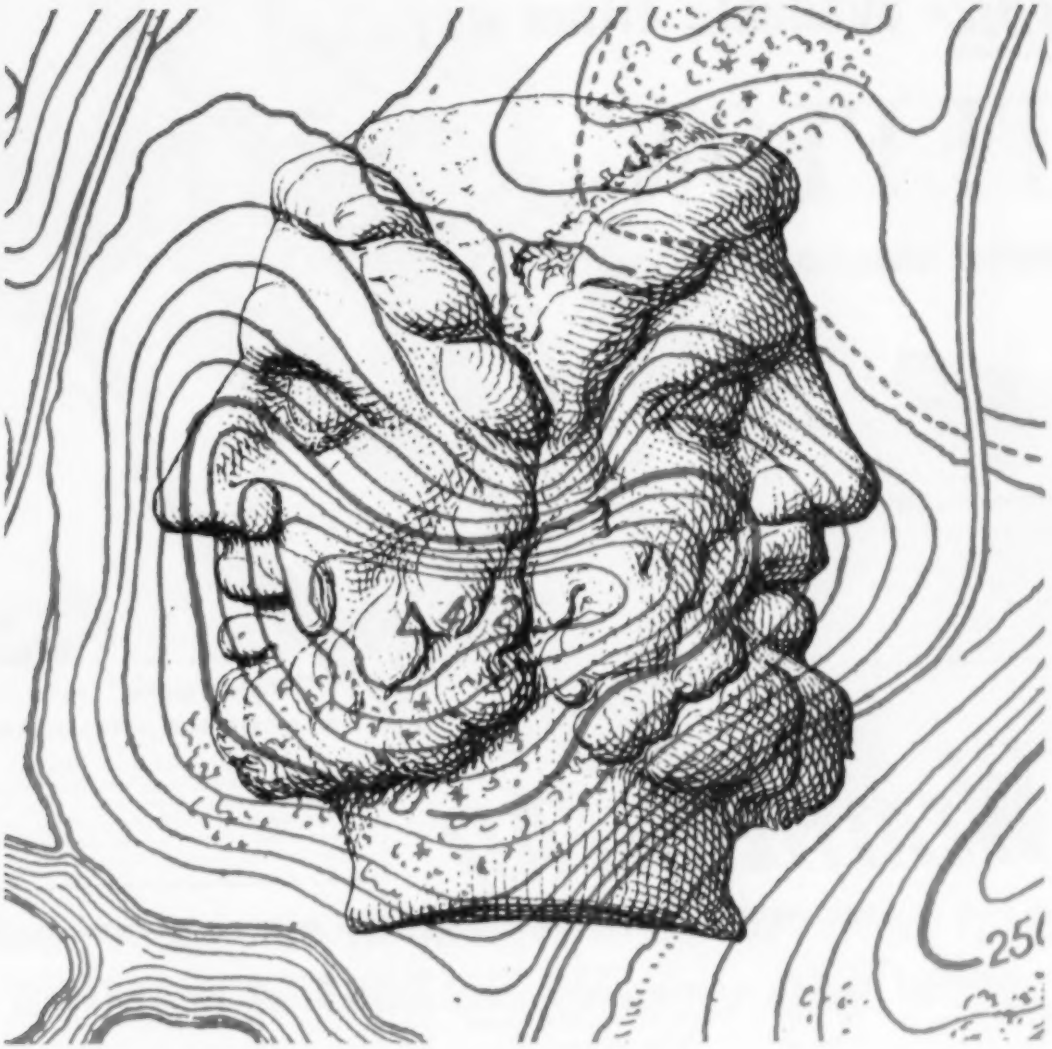
CAREER OPPORTUNITIES: Excellent openings for qualified engineers

BARBER-COLMAN COMPANY

Dept. V, 1422 Rock Street, Rockford, Illinois

Aircraft Controls • Electrical Components • Automatic Controls • Industrial Instruments • Air Distribution Products
Small Motors • Overdoors and Operators • Molded Products • Metal Cutting Tools • Machine Tools • Textile Machinery

Time-
saving
service
for
missile engineers
assembly and easy detachability . . . or for
permanent holding power combined with
resistance to shock, vibration and atmos-
pheric conditions . . . Monadnock's design
staff is ready to work with you and relieve
your own engineers for more basic
problems.
Write for further information on
special-purpose devices currently
available and details of the produc-
tion facilities Monadnock can
put at your service.
MONADNOCK
MILLS
San Leandro, California
A Subsidiary of UNITED-CARR FASTENER CORPORATION



## Janus Comes Down To Earth

ROMAN MYTHOLOGY's guard of the gates of Heaven was a concept which anticipated the many-sighted eye of today's color display tube. Color designation in display of microwave information increases our ability to differentiate moving from stationary objects, enemy from friendly aircraft, hazardous from safe terrain, meaningful signals from noise—to name only a few uses. We have for you a brochure on industrial and military applications of the Lawrence *single-gun* color display tube. Included in the brochure is an explanation of Post Deflection Focusing.

**LITTON INDUSTRIES** BEVERLY HILLS, CALIFORNIA

*Plants and Laboratories in California, Maryland, Indiana, Utah and New York*

DIGITAL COMPUTERS & CONTROLS · RADAR & COUNTERMEASURES · INERTIAL GUIDANCE · SPACE SIMULATION RESEARCH
MICROWAVE POWER TUBES · AUTOMATIC DATA PROCESSING · SERVOMECHANISMS · PRECISION COMPONENTS & TRANSFORMERS

# *Now* available either way...

# TEFLON*

## HOSE ASSEMBLIES

with this

**BRAID-LOK FITTINGS**

**PERMANENTLY ATTACHED**

Factory-assembled and individually tested under close supervision, BRAID-LOK fittings are designed to grip the wire braid between metal surfaces. Teflon inner liner is trapped separately, forming a perfect seal . . . the higher the pressure, the tighter the seal. Meets the latest military standards.

or this

**"super gem*" FITTINGS**

**DETACHABLE – RE-USABLE**

Can be attached or removed in the field, using standard bench tools. Design assures three functions: (1) grips and holds the external wire braid firmly; (2) seats the inner tube without compression thus forming a lip seal; (3) positive metal-to-metal line seal.

by

# WEATHERHEAD

## LEAK-PROOF BLOW-OFF-PROOF FOR EXTREME TEMPERATURES

- For the first time from one major source, Teflon hose lines are now available equipped with either detachable (re-usable) or permanently attached fittings according to user preference.
- Reliable operation at high pressures, in extreme temperature range (−65°F to +500°F.)
- Chemical inertness and resistance to corrosive action of practically all aviation fluids, within the above temperature range.
- Flexibility plus resistance to expansion, contraction, and fatigue failure.
- Indefinite shelf life (non-aging).
- Lighter weight plus space-saving advantage.
- Freedom from line contamination.
- Tested to conditions in excess of MIL H-25579 requirements and those of airframe, engine and missile manufacturers.

*"super gem" is an Aeroquip trademark.

*"Teflon" is a Dupont trademark.

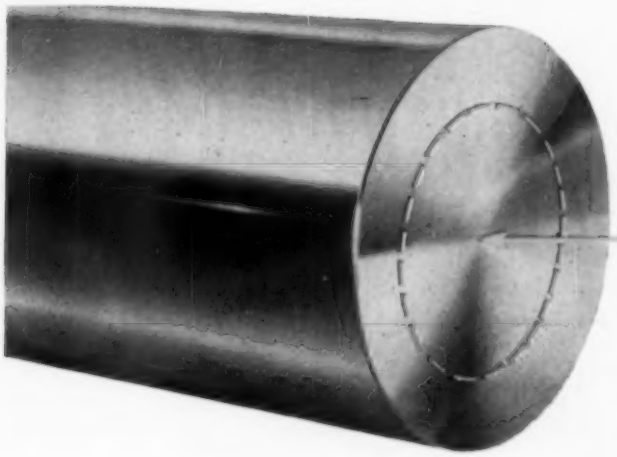
**THE WEATHERHEAD COMPANY, *Aviation Division***

**300 E. 131st STREET • CLEVELAND 8, OHIO**

West Coast: 1736 Standard Ave., Glendale, Calif. Cable address: WEATHCO
In Canada: 127 Inkerman St., St. Thomas, Ontario Distributors in Principal Cities

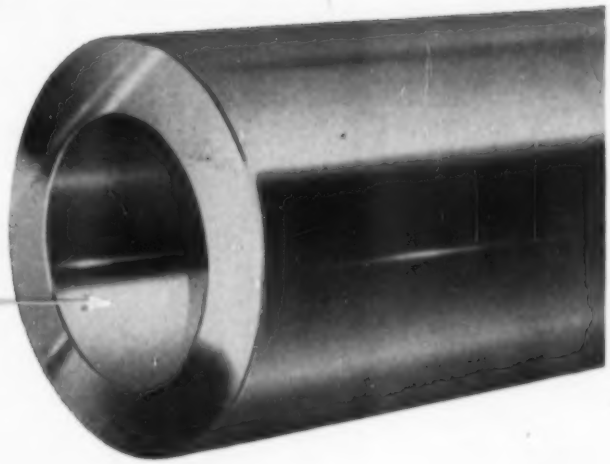
MS-ER FLARELESS Tube Fittings | HYDRAULIC CYLINDERS | HOSE • HOSE ENDS • HOSE ASSEMBLIES | SPECIAL TUBE ASSEMBLIES | FORGINGS (Cored or Solid) | MS-ER FLARELESS Cluster Fittings | ROTOMITE Swivel Joints | Valves and DRAIN COCKS

**FIRST IN HYDRAULIC AND FLUID SYSTEM COMPONENTS**



*Why bore this out . . .*

*when you can get the hole ready-made?*



# Save money on hollow parts by switching from bar stock to TIMKEN® seamless steel tubing

Check these savings you get when you make hollow parts with Timken® seamless steel tubing instead of bar stock:

1. **NO HOLE TO DRILL**—it's already there.
2. **ELIMINATION OF COSTLY BORING OPERATION** frees part of your screw machines for other jobs—adds machining capacity *without* adding machines.
3. **MORE PARTS PER TON OF STEEL** because there's less metal to hog out.

And with Timken seamless steel tubing you get better quality finished products. The piercing operation by which Timken seamless steel tubing is made gives the tubing its fine forged quality. A solid round is forged over a mandrel, thoroughly working the metal inside and out. Accurate temperature and piercing speed control combine to produce uniform, fine forged quality. And we maintain this quality from tube to tube, heat to heat, order to order.

Timken Company engineers are always ready to study your problems, recommend the most economical tube size for your hollow parts job—a size guaranteed to clean up to your dimensions. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

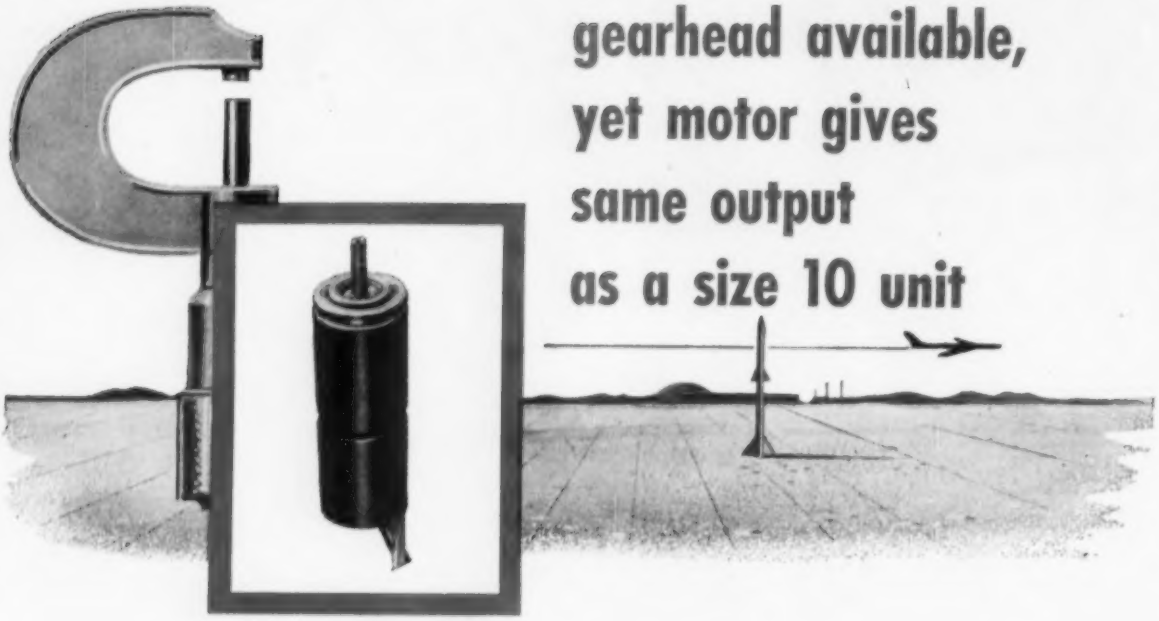
**TIMKEN** *Fine Alloy* **STEEL**

TRADE-MARK REG. U.S. PAT. OFF.

**See the next Timken Televent hour, "The Innocent Years" over NBC-TV, Thursday night, November 21st.**

# EDISON'S SIZE 8 GEARHEAD MOTOR

## smallest diameter gearhead available, yet motor gives same output as a size 10 unit



**OPERATING CHARACTERISTICS:**

- Type of motor: Two phase
- No load speed (Min. R.P.M.): 6200
- Stalled torque (Min. in. oz.): 0.20
- Power input at stall (Nom. watts/phase): 1.7
- Speed at max. Power output (R.P.M.): 3950
- Torque at max. Power output (in. oz.): 1.2
- Theoretical acceleration at stall. 16,800 radians/sec.$^2$
- Time constant: 0.0416 sec.
- Duty: Continuous at stall

The Edison Instrument Division has met the challenge of greater miniaturization in servo motors for aircraft and missiles. The size 8 Gearhead Motor shown here is a typical example. This particular Edison unit can be supplied in any gear ratio within 2% and has the smallest diameter gearhead now available. Add to this salient feature the fact that this unit gives the same output as a size 10 motor and you have an ideal motor for such miniaturized projects as small panel mounting instrumentation and small computers for aircraft. Its light weight also makes this gearhead motor easily adaptable for missiles work.

The Edison Instrument Division now has this unit available in production quantities for fast delivery. Permanent tooling assures quality production of both short run and volume orders.

The Edison Instrument Division invites your inquiry. Write or wire for complete technical details. Mention your application.

**Thomas A. Edison**
INDUSTRIES
INSTRUMENT DIVISION
97 LAKESIDE AVENUE WEST ORANGE, N. J.

McGRAW EDISON

# TO CONVERT OR ABSORB THERMAL EFFECTS AT LOW COST SYLPHON BELLOWS AND ASSEMBLIES

**Whether design problems involve thermal, pressure or mechanical effects, Fulton Sylphon can help you use the simple, foolproof bellows principle to best advantage. For one thing, an unmatched engineering service assures you of the *right* bellows or bellows assembly. Specialized skills and facilities also enable Fulton Sylphon to produce *complete* bellows assemblies at lower cost than you could yourself. And only from Fulton Sylphon can you get the extra know-how that comes from 52 years of experience with every conceivable bellows application!**

**Send for Bellows Bulletin TA-1400**

FULTON SYLPHON

BELLOWS HEADQUARTERS, U.S.A.

Robertshaw-Fulton

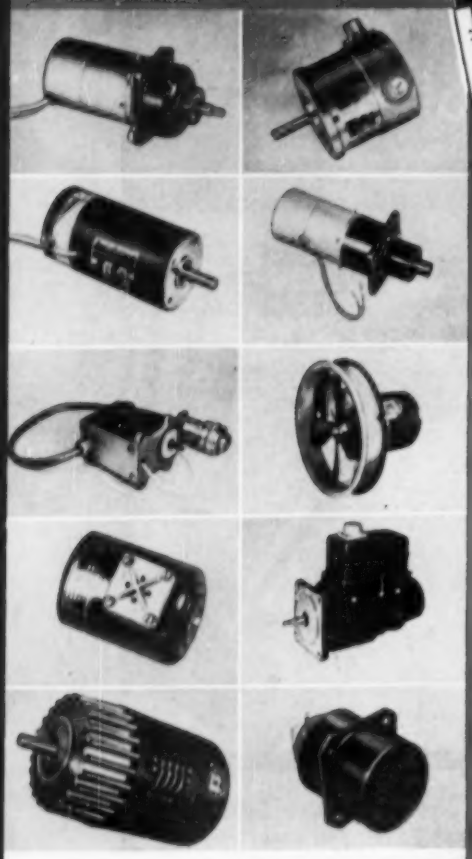
CONTROLS COMPANY

Mr. Controls

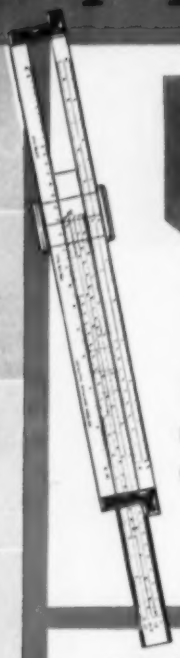
FULTON SYLPHON DIVISION • Knoxville 1, Tenn.

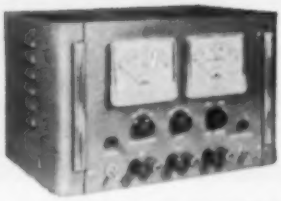
# Here they are!

# WESTERN GEAR answers to your electrical equipment problems...



Pictured above are only a few of Western Gear's complete miniature motor line, ranging from 1/500th to 4 HP. Choose from cycle ranges of 50 to 400 at any voltage required. Furthermore, if our basic designs do not meet your particular requirements, our engineers will be glad to work with you on your rotary electrical problems WITHOUT OBLIGATION!

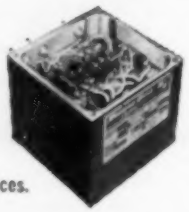


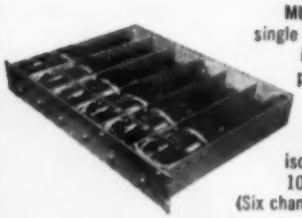


**LABORATORY-TYPE POWER SUPPLY**— New from Western Gear, Electro Products Division, is this lab-type, voltage-regulated power supply, available in either cabinet or rack type mounting. Input voltage is 105 to 125 volts at 50 to 60 cycles per second. Three output voltages are available . . . continuously variable 0 to 300V DC at 150 MA; continuously variable 0 to negative 150V DC at 5 MA; and 6.3V AC at 8 amperes. For full information, use the coupon below.

**STROBOSCOPE UNIT**— Now available, a reasonably-priced, compact, true-color stroboscope for viewing rotary, reciprocating or repetitive motion, as designed and manufactured by Western Gear's Electro Products Division.
SPECIFICATIONS: Flash duration, 10 microseconds; light output, 5 Lumen seconds per flash; repetition rate, 0 to 100 pulses per second; dimensions, 6" wide, 5" high, 5¾" deep.
For complete information, mail the coupon below.

**TRANSISTORIZED VOLTAGE REGULATOR**— Rugged conditions are made to order for this precision unit, especially where performance, space and weight are of extreme importance.
The circuitry employs a shunt power transistor and a temperature-compensated Zener diode reference voltage. Input voltage is 31V DC plus or minus 4V. Output of the 7VR12 is 5V DC at 100 to 200 MA. Regulation less than plus or minus .1 per cent for combined variations of input voltage, load current, temperature, drift and vibration. Dimensions 2 x 2 x 2. Weight 8.5 ounces.
For more of the story, check and mail the coupon below.





**MULTIPLE CHANNEL STRAIN GAGE POWER SUPPLY**— Model 7P01 single or multiple channel strain gage power supply, 115 V, 60 cycle input, 10V DC output, adjustable from 9-11V DC with a 10-turn potentiometer. Output voltage changes less than plus or minus .05% due to temperature change from 0 to 45°C; output voltage changes less than .1% due to 2% change in load current. Output ripple is less than 300 microvolts RMS, isolated from ground as follows: insulation resistance to ground, 10,000 megohms; AC pickup voltage to ground, 5 microvolts peak. (Six channel unit shown.) For complete information, mail coupon below.

CLIP AND SAVE

Glenn Malme • WESTERN GEAR CORPORATION • P.O. Box 182, Lynwood, California

Please send information checked:

- ☐ Motor Catalog No. 254-A
- ☐ Data sheet on Voltage Regulator
- ☐ Data sheet on Strain Gage Power Supply
- ☐ Data sheet on Lab-type Power Supply
- ☐ Data sheet on Stroboscope Unit

Name_____

Title_____

Company_____

Address_____

City_____ State_____

*The difference is reliability* • Since 1888

WESTERN GEAR Corporation

ENGINEERS AND MANUFACTURERS

PLANTS AT LYNWOOD, PASADENA, BELMONT, SAN FRANCISCO (CALIF.)
SEATTLE AND HOUSTON — REPRESENTATIVES IN PRINCIPAL CITIES

October 7, 1957

# AVIATION WEEK

Vol. 67, No. 14

**Editorial Offices**

New York 36—330 W. 42nd St., Phone: LOngacre—4-3000 (Nights LO 4-3035)
Washington 4, D. C.—National Press Bldg., Phones: NAtional 8-3414, REpulic 7-6630
Los Angeles 17—1125 West Sixth St., Phone: MAdison 6-9351
Dallas 1—1712 Commerce St., Phone: RIverside 7-5117

European Office—1 rue du Temple, Geneva, Switzerland

PUBLISHER.....Robert W. Martin, Jr.
EDITOR.....Robert B. Hotz

MANAGING EDITOR.....Alpheus W. Jessup
ASST. MANAGING EDITOR (TECHNICAL)
David A. Anderton
WASHINGTON.....Cecil Brownlow
NEW YORK.....William Gregory,
Robert I. Stanfield, Harry Raven
LOS ANGELES.Irving Stone, Richard Sweeney
DALLAS.....Craig Lewis
ENGINEERING.....Robert H. Cushman,
Russell Hawkes, J. S. Butz, Jr.
AVIONICS...Philip J. Klass, James A. Fusca
CONGRESS.....Katherine Johnsen
MILITARY.....Claude O. Witze, Evert Clark
TRANSPORT.....Glenn Garrison, L. L. Doty,
Ford Eastman
EQUIPMENT.....G. L. Christian
BUSINESS FLYING.....Erwin J. Bulban
ART EDITOR.....Lawrence J. Herb
ASST. ART EDITOR.....Robert G. Young
EDITORIAL PRODUCTION...Jerome E. Kelley
EDITORIAL ASSISTANTS..Elizabeth M. Hein,
Marjorie Nail, Jerome Bailey, Edith Walford
LIBRARIAN.....Jeanne Rabstejnek

FOREIGN NEWS SERVICE

EDITOR.....John Wilhelm
LONDON.....William J. Coughlin
PARIS.....Robert E. Farrell
BONN.....Morrie Helitzer
MEXICO CITY.....John H. Kearney
RIO DE JANEIRO.....Peter Weaver
TOKYO.....Dan Kurzman

DOMESTIC NEWS BUREAUS

ATLANTA 3.....1301 Rhodes-Haverty Bldg.
CHICAGO 11.....520 No. Michigan Ave.
CLEVELAND 15.....1510 Hanna Bldg.
DETROIT 26.....856 Penobscot Bldg.
HOUSTON 25.....1303 Prudential Bldg.

SALES

ADVERTISING SALES MANAGER
E. P. Blanchard, Jr.
PROMOTION AND RESEARCH MANAGER
W. H. Jack
ATLANTA.....R. H. Powell
BOSTON.....A. C. Boughton
CHICAGO and ST. LOUIS.....J. S. Costello,
F. E. Bauman
CLEVELAND.....H. P. Johnson
DALLAS.....Gordon Jones, E. E. Schirmer
DENVER.....John G. Patten
DETROIT.....C. A. Ransdell
LOS ANGELES.....C. F. McReynolds,
D. T. Brennan, D. A. McMillan
NEW YORK.....M. J. Storz,
R. G. Hathaway, R. R. Butera
PHILADELPHIA...J. D. Willis, W. L. Blanchard
SAN FRANCISCO.....William Woolston

BUSINESS

BUSINESS MANAGER.....J. G. Johnson
CIRCULATION MANAGER.....T. J. Lucey
PRODUCTION MANAGER.....W. V. Cockren

RESEARCH AND MARKETING

Mary Whitney Fenton,
Judith P. Wheeler, Eleanor Di Preta

**Missile Watchers Pierce Patrick Secrecy** ..... 26
▶ Housewives, motel owners know what will be fired and when despite official pretenses.

**Tight Money Threatens Jet Stretchout** ..... 38
▶ Airlines ability to meet re-equipment loans, make new ones to be major issue in fare investigation.

**Solid Fuels Contend for Ballistic Role** ..... 50
▶ Projects indicate progress in thrust control and weight efficiency in this propellant.

MISSILE ENGINEERING

Anti-Missiles Lag ..... 29
Missiles Won't Change Missions ..... 33
40-Lb. Thrust Rocket Motor ..... 59

AERONAUTICAL ENGINEERING

Structural Assembly of First Electra .. 65
Aircraft Operators Warned ..... 67
GM Seeks 'Fluidity' in R&D ..... 70
Hiller Assembles VTOL ..... 86
Baroudeur Performs for NATO ..... 130
Taon Competes for NATO Role ..... 132

AVIONICS

Aeronutronics Expands ..... 31
Experts Loaned to AMB ..... 34
Politics in ICAO Talks ..... 37
Radio Web Enters Navaid Race ..... 109
Changes in Avionics Industry ..... 123
Filter Center ..... 125

EQUIPMENT

New Aviation Products ..... 95
Plane Gives Tow Unit Traction ..... 137
Off the Line ..... 145
What's New ..... 149

AIR TRANSPORT

New Engine Failure Hits Britannia ... 39
Titanium Used on Ilyushin-18 ..... 43
Airline Observer ..... 45
Shortlines ..... 45
Airline Income & Expenses ..... 47

BUSINESS FLYING

Contractors Enter Business Market .. 32
Colonial's New Four-Seat Amphibian . 153
Helicopter Grosses 490 Lb. ..... 155
Roadable Plane Tested ..... 157
Private Lines ..... 157

FINANCIAL

CAA Contracts ..... 151
Army Contracts ..... 151

MANAGEMENT

USAF Sets Monthly Limits ..... 30
French Cutbacks Threatened ..... 31
Ramey Stresses Simplicity ..... 34
Who's Where ..... 23
Industry Observer ..... 23
Washington Roundup ..... 25

Calendar ..... 5
Letters ..... 174

EDITORIAL

TWA Hits Comeback Trail ..... 21

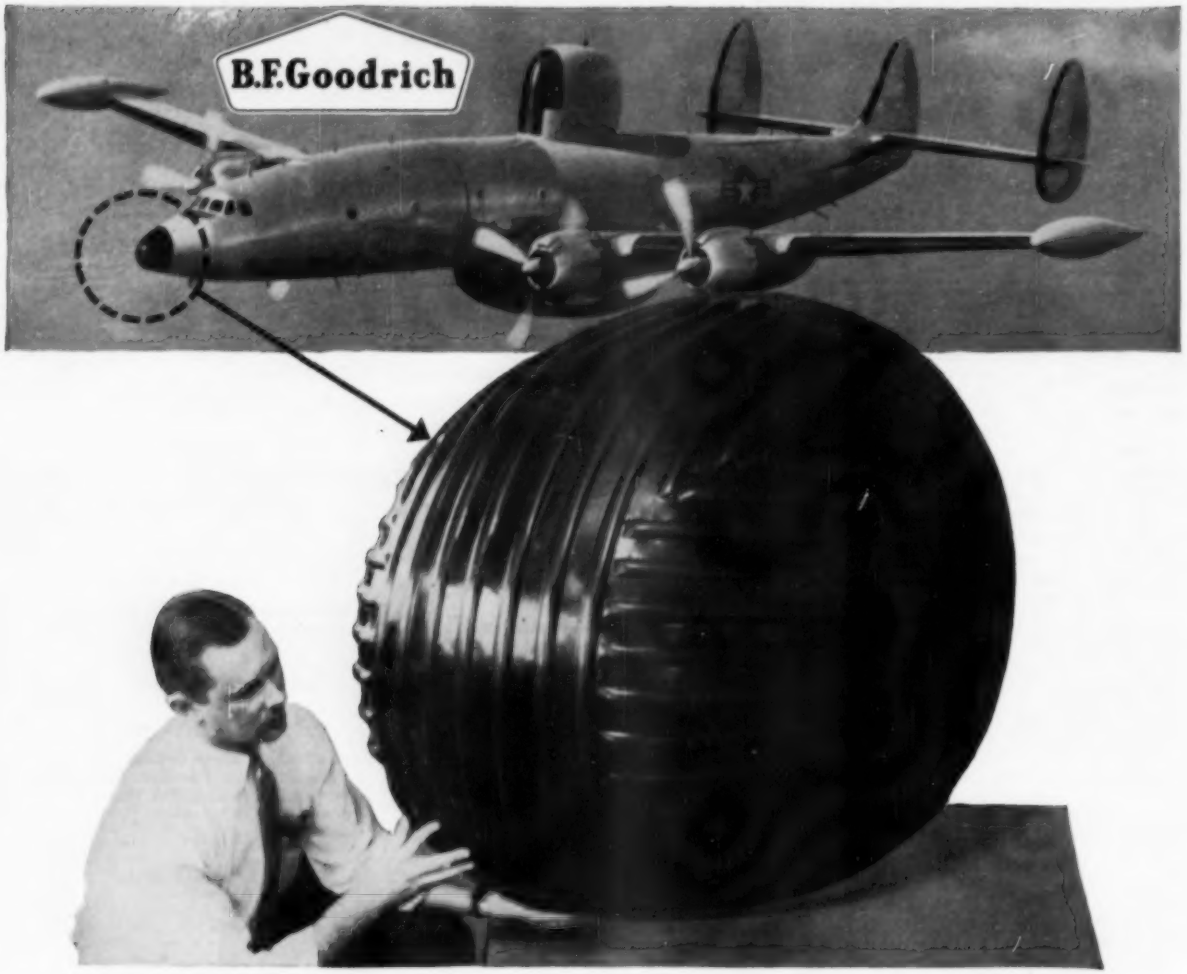
**COVER**· First of four Lockheed Electras in final assembly is externally complete with the exception of powerplants, to be installed in about a week. Photo was taken at 2 a.m. to get view unobstructed by work crews and stands. Work in progress at that time entailed installation of electrical and hydraulic gear in lower fuselage. Hydraulic and electrical system checkouts are scheduled for late October; landing gear swing tests, other functional checks for November. Rollout is planned for December; first flight is due in January (other pictures on p. 65).

Picture Credits:
26, 146—Wide World; 27—Evert Clark; 63, 130, 131, 131—Russell Melcher; 67, 86, 153, 155—Howard Levy.

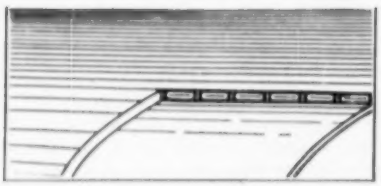
70,059 copies of this issue printed

AVIATION WEEK • October 7, 1957 • Vol. 67, No. 14

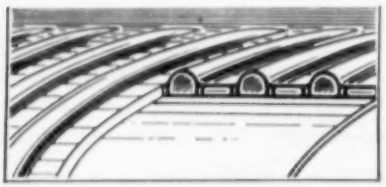
Member of ABP and ABC




# Pneumatic De-Icers keep radomes clear without distorting radar signal



Shown in relaxed position De-Icer's small rubberized fabric tubes are in line with the airstream to provide minimum air resistance during operation.



Tubes inflate and deflate in alternate pairs to snap off ice formations. Action is positive, dependable and simple.

GIANT BULGES distinguish the Navy's Lockheed WV-2, a vital link in our "early warning" defense system. Inside the bulges and in the nose are more than six tons of powerful, sensitive radar equipment.

Ice building up on the large exposed areas of these radomes can foul the radar signal. But lightweight B.F.Goodrich Pneumatic De-Icers, operating with compressed air, allow the radar to scan effectively at all times, with no excessive loss of radar energy. B.F.Goodrich De-Icers also protect radomes from abrasion, erosion and hail damage.

Pneumatic De-Icers are also on wing and tail leading edges giving the WV-2 complete B.F.Goodrich protection against ice hazards.

### COMMERCIAL AIRLINERS, TOO

B.F.Goodrich Pneumatic Radome De-Icers, in constant use on military early warning planes, are now being adopted for commercial airliners, too. Whether you have aircraft in the design stages or in actual use, B.F.Goodrich Aviation Products engineers will be glad to show you how Pneumatic Radome De-Icers assure greater efficiency of radar equipment.

## B.F.Goodrich Aviation Products

**a division of The B. F. Goodrich Company, Akron, Ohio**

**Tires • Wheels • Brakes • De-Icers • Inflatable seals • Fuel cells • Heated Rubber Pressure Sealing Zippers • Rivnuts • Avirim • Adhesives • Hose and rubber accessories**

# EDITORIAL

# TWA Hits the Comeback Trail

In seeking a pleasant respite from the clattering typewriters of AVIATION WEEK's offices on a deadline day, we recently spent an afternoon flying around the eastern seaboard with Trans World Airlines' new president, Carter Burgess, some of his staff and a quorum of the airline's directors as they held a board meeting in a newly styled Lockheed Model 1649 Jetstream some 19,000 ft. in the air.

Main purpose of this meeting was to acquaint the directors with TWA plans to carve out a larger slice of the transcontinental market this winter. For us it was an opportunity to really get acquainted with the Model 1649 and renew old friendships with some of the TWA veterans who did so much to educate me in the gruelling discipline of instrument flying back in the early wartime days of the Air Transport Command.

## Realistic Atlantic Nonstop

Talking with Bob Buck, a veteran pilot now special adviser to TWA's president on jet transport integration, and Bob Rummell, engineering vice-president, we get the idea that the Jetstream has really proved itself in the transatlantic service this summer as a genuine westbound nonstop aircraft. During the three summer months TWA had 98% completion of westbound nonstop schedules between London, Paris and New York.

Buck told of a September trip he flew after inspecting Britannias at Bristol in which he carried a full Jetstream tourist load of 75 passengers nonstop from London to New York under typical North Atlantic westbound weather. He had a mean headwind component of 46 kt. and picked up heavy ice climbing out of London that stayed with him for several hours. He still had two hours gas reserve on landing at Idlewild. In the pilot's book this is realistic nonstop westbound performance. Last week a Jetstream carried 44 passengers nonstop 5,900 miles from London to San Francisco in 23 hr. 19 min.

Bob points out that while the maximum cruise of the Jetstream is about 15 kt. slower than its hottest competitor on both the Atlantic and transcontinental runs it can do as good if not slightly better block to block speed because of a faster rate of climb that gets it to optimum cruise altitude sooner and a larger fuel capacity that does not require the leaned out mixture and consequent retarded cruising speed of the long range cruise techniques necessary with less fuel margin.

## Noise Control

Sitting in the noisiest seats in the Jetstream, just opposite the engines, with Bob Rummell, we got a good demonstration of the effective soundproofing techniques applied to this aircraft. Even during takeoff Bob and I could converse with normal voice level and in cruising flight you can eavesdrop on conversations clear down the cabin. Soundproofing the cabin of the Jetstream costs 900 extra pounds of weight and is the result of a joint TWA-Lockheed research program on a Super-G Constellation.

In addition to the cabin soundproofing, propeller throb is reduced below audible level by synchrophasing the Hamilton Standard propellers and using relatively low revolutions per minute that slows blade tip speed considerably. The Wright Turbo-Compound engines are also pushed farther out along the wing away from the fuselage.

The Jetstream is now the backbone of the TWA fleet and both pilots and management say they could use about double the 25 planes currently in service in the drive to re-establish TWA's competitive position on the key domestic and international runs.

TWA's "new look" program also involves new passenger service techniques and will lean heavily on the use of the pilot and flight crew as salesmen of the airline's service. Flight crews will sport a new black and gold uniform next year and each captain will have a new red and white nameplate hung on the loading ramp that will identify him to passengers before they enter the aircraft as well as in flight. The new "Siesta seats" are extremely comfortable for long range operations and combined with the pressurization, soundproofing and good food and drink should set a new standard in first class passenger comfort.

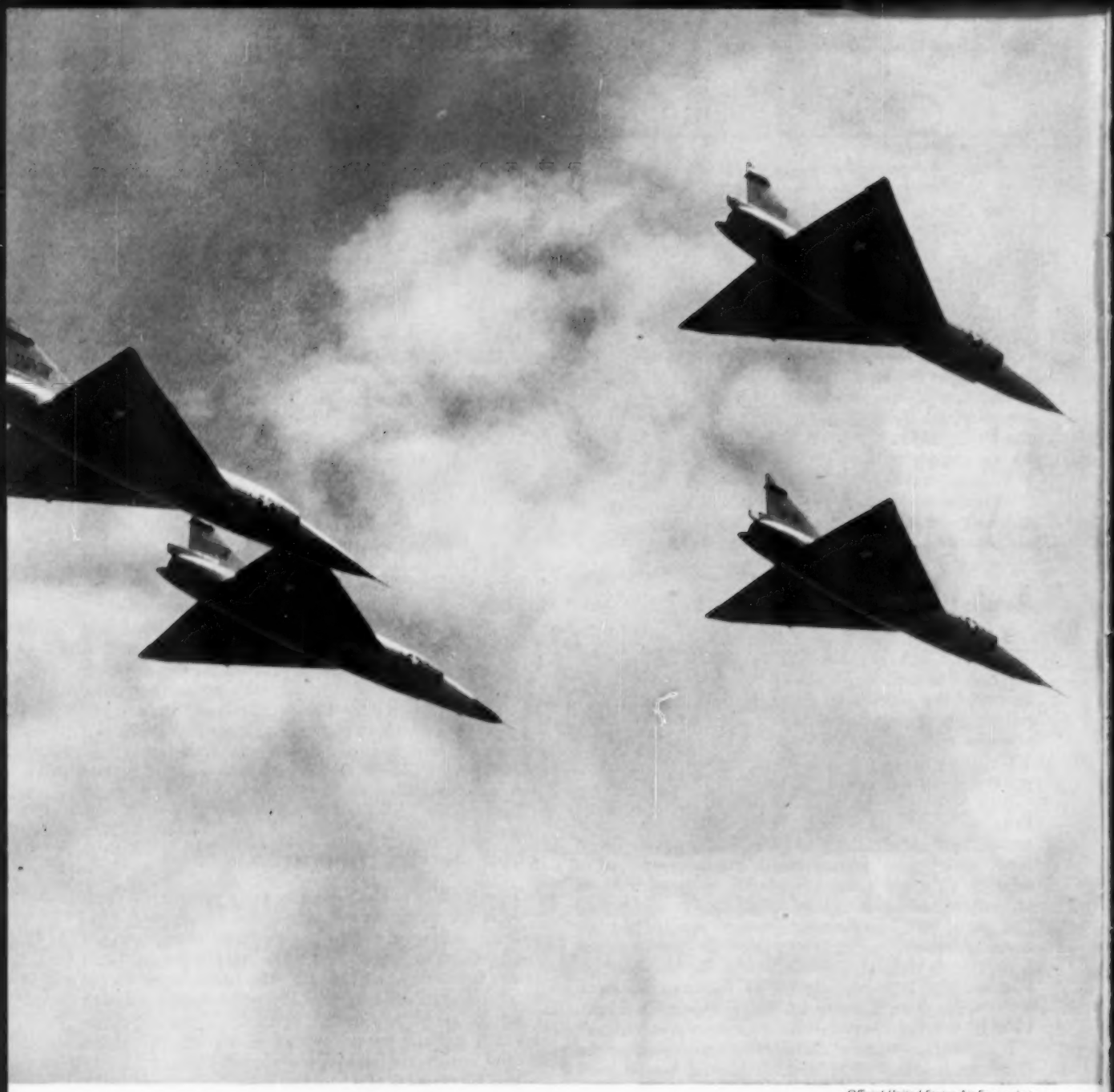
## Food Service Improvements

Two touches in the food service we particularly liked. One is the technique of bringing aboard a whole beef sirloin, keeping it hot in an oven and then slicing it into serving portions as the meal is actually served. This makes a juicy morsel indeed. The other is the choice of a full-bodied red French Medoc wine that is a pleasant relief for people who enjoy fine food, although champagne is available for the type of person who enjoys the elegant luxury its bubbles traditionally convey.

It is pleasant for one who has known and flown TWA since the days of its Boeing 307s to see this old and fine airline come alive again under the touch of vigorous leadership provided by Carter Burgess. Although it is still much to early to render a verdict on this stewardship, there are some tangible straws in the TWA wind. For the first six months its net loss shrunk by about $600,000 and in June a net operating income before taxes of $4 million was posted compared to $1.7 million for the same month in 1956. Third quarter figures should also be written in black ink.

TWA still has a long way to go to recapture the competitive position it once enjoyed. But under Carter Burgess' leadership and bolstered by a hard core of seasoned veterans in the flying business TWA has definitely hit the comeback trail.

—Robert Hotz



Official United States Air Force photo

# TITANIUM METALLURGY IN MOTION

In developing aircraft of higher and higher performance, the aircraft industry also created the demand for increasingly high-performance alloys. With the industry's co-operation, Rem-Cru technical teams developed most of the basic *titanium alloys* in use today, and are producing them in tonnage quantities to meet aircraft quality standards.

**REM-CRU TITANIUM**

**World's Most Versatile Metal**

**MIDLAND, PENNSYLVANIA**

*The July issue of the Rem-Cru Review is devoted to guided missiles. Ted Macuin, North American-Downey, is guest editor. Write Dept. A-10 for your copy.*

**Sales Offices:** 6033 East Bandini Boulevard, Los Angeles 22, California • 4501 W. Cortland Street, Chicago 39, Illinois • 405 Lexington Avenue, New York 17, N. Y.

# WHO'S WHERE

## In the Front Office

**John M. Carter**, president, California Technical Industries, division of Textron, Inc., Belmont, Calif.

**Donald D. Flitton**, president and board chairman, the recently incorporated Flitton & Kissinger Engineering Corp., Northridge, Calif. Also: **Robert G. Kissinger**, executive vice president; **Jean V. Hansen**, secretary-treasurer; **H. Edward Olcott**, vice president-engineering; **Charles Gentry**, public relations counsel.

**Everett M. Patterson**, president and a director, Bulova Research and Development Laboratories, Inc., Woodside, N. Y.

**John R. Bly**, vice president-general manager and a director, Eckel Valve Co., San Fernando, Calif. Also: **Edward P. Martin**, sales manager.

**Lester A. Wells**, executive vice president, Thieblot Aircraft Company, division of Vitro Corporation of America, Washington.

**Dr. George E. Valley**, of the Massachusetts Institute of Technology, succeeds **Dr. Courtland D. Perkins** as Chief Scientist of the United States Air Force, Washington, D. C. Dr. Perkins has returned to Princeton University as Chairman of the Aeronautical Engineering Department.

**Col. Benjamin G. Holzman**, Director of Research, Air Research and Development Command, Baltimore, Md. Col. Holzman succeeds **Col. L. B. Williams** now Deputy Chief of Staff for Operations, ARDC's Air Force Cambridge Research Center, L. G. Hanscom Field, Bedford, Mass. **Col. Paul M. Butman** succeeds Col. Holzman as Director of Air Weapons, ARDC Headquarters, Baltimore.

**Maj. Gen. Hamilton H. Howze**, Director Army Aviation, Office of the Deputy Chief of Staff for Operations, Washington, D. C., has been assigned to Headquarters, Eighth U. S. Army (Korea).

**Bert Marshall**, manager of customer relations-Washington, D. C. office, Crosley Division, Avco Manufacturing Corp., Cincinnati, Ohio.

**David A. Moffit**, assistant to vice president-public relations, Air Transport Association of America, Washington, D. C.

## Honors and Elections

**John S. Anderson**, president of Aeronautical Radio, Inc., has been elected chairman of the Radio Technical Commission for Aeronautics, Washington, D. C. Mr. Anderson succeeds **Dr. J. H. Dellinger**, retiring after 17 years; by acclamation, Dr. Dellinger was elected to lifetime post of Technical Advisor on Administration and Organization to RTCA.

## Changes

**Manuel A. Sanchez**, jet project coordinator-Miami overhaul base, Pan American World Airways, Inc.

**Ralph S. Maugham**, director-passenger conference and interline activities, American Airlines, Inc.

**L. A. Botkin**, chief engineer, Buckeye Iron & Brass Works, Dayton, Ohio.

# INDUSTRY OBSERVER

► Excavation is under way at Cape Canaveral, Fla., missile launching site for installation of underground equipment that will simulate ship motion. Equipment is part of launch complex for firings of Navy's solid-propellant Polaris intermediate range ballistic missile. Operationally, Polaris will be fired from ships and submarines. Launch must compensate for roll, pitch and yaw of the vessel.

► **Third firing of USAF-Convair Atlas intercontinental ballistic missile will take place before the end of next month if the present schedule holds.**

► Atlas reached approximately 15,000 ft. in its second firing from USAF Missile Test Center, Patrick AFB, Fla. (AW Sept. 30, p. 30). First test model fired last June (AW June 17, p. 27) reached more than the 5,000 ft. generally reported but less than 10,000 ft.

► **Sikorsky S-61 turbine-powered helicopter (AW Sept. 2, p. 23) is being designed for Navy with the ability to remain afloat for indefinite periods in the event of emergency landings on water. Aircraft has flying-boat hull with sponsons. Leading edge of sponsons are set at high angle of attack to aid in takeoff. Twin-turbine engines, probably General Electric T58s, are mounted above the cabin, which will have space for approximately 20 persons. Sikorsky also believes the helicopter will have a commercial potential, particularly among off-shore oil operators.**

► Aerojet General has now completed a number of static firings of its solid propellant rocket motor designed for use in Navy's Polaris ballistic fleet missile. Since the rocket motor is not an integral part of the missile structure, it can be static fired in the missile airframe and removed after burnout, making way for a new motor. Unit is largest solid propellant rocket engine built in the U. S. thus far (AW May 27, p. 23).

► **North American Aviation Inc.'s long-range interceptor design for the Air Force (AW May 20, p. 37) has been designated F-108.**

► Nose cone configuration for the operational Atlas has not yet been frozen. Blunt, corrugated nose pictured in unofficial drawings (AW Sept. 2, p. 28) may not be the final design.

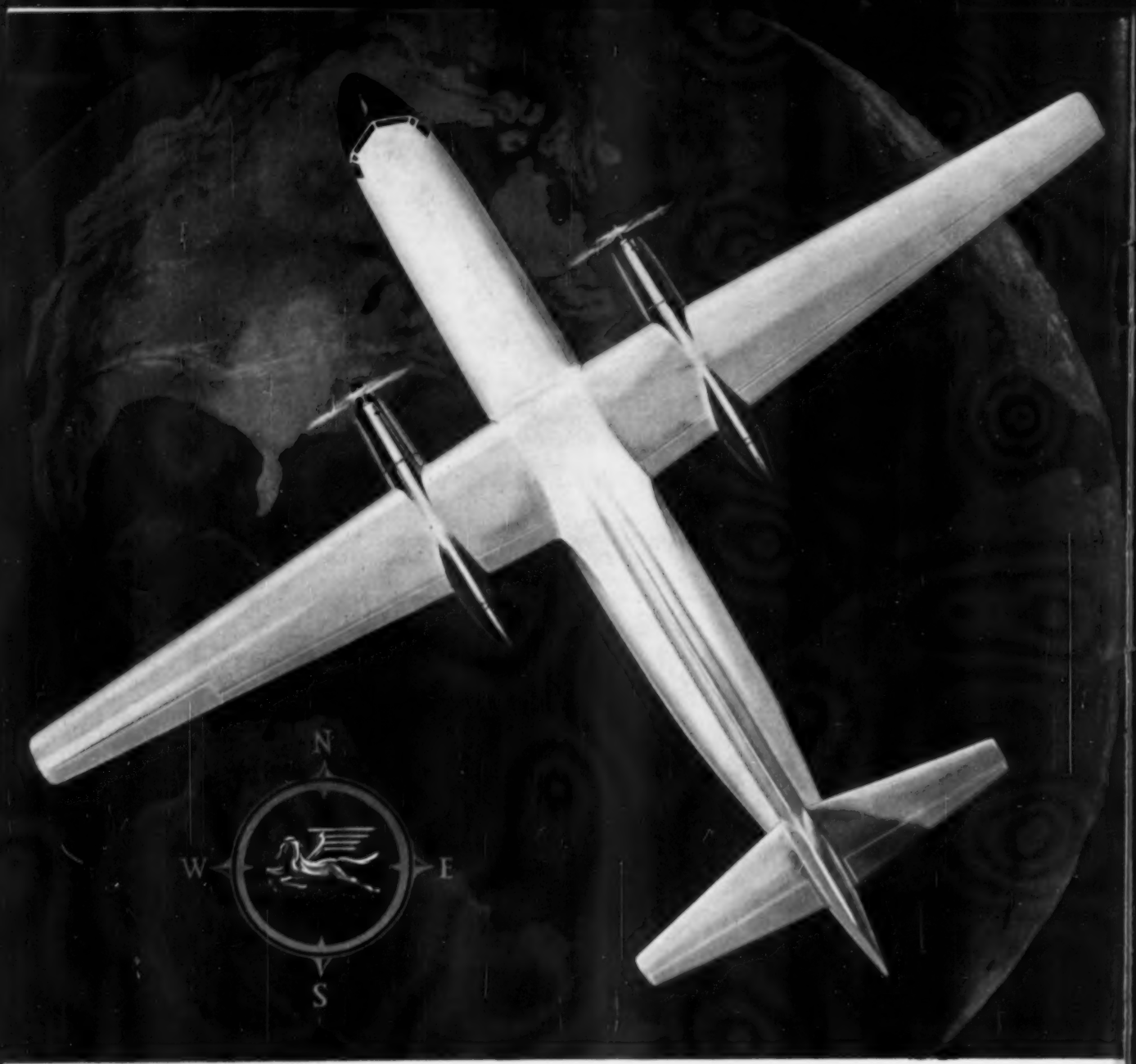
► **Atlas missiles are being static test fired in a missile test stand at Edwards AFB, Calif., rocket base on Leuhman Ridge before shipment to Patrick. Missiles are put into position while still on the carrying trailer. Trailer and missile are raised to vertical position together; then the trailer is lowered alone after the missile has been secured.**

► Soviet Union has employed single sideband communications for several years but is just now beginning to investigate the possibilities of forward scatter.

► **Piper Aircraft's 1958 models to be announced later this month will include new versions of the Apache light twin and Tri-Pacer fitted with Lycoming high-compression engines providing 10 hp. more than the present 150-hp. O-320s. Engines will improve the aircraft's consumption and permit gross weight increases.**

► Most important air navigation problem in Soviet Union today is need for improved landing aids. Aeroflot engineers at current ICAO meeting in Montreal have shown great interest in ILS and GCA training films. Inside Russia, en route air navigation is all by non-directional beacon and automatic direction finding. Only anticipated need for a long range navigation system is for flights outside USSR's territorial boundaries.

► **Westinghouse's Gas Turbine Division is carrying out work on steam turbines for other divisions of the company in order to offset declining aircraft engine business.**




# World-wide maintenance for the F-27

Corporations operating Fairchild F-27's as executive aircraft can be assured of maintenance the world over. With more and more customers purchasing F-27's throughout the Free World, overhaul and spares services will always be nearby. The F-27's Rolls-Royce Dart propjet engines are backed by a world-wide network of service facilities.

Many corporations have decided that the F-27 is the aircraft to modernize their fleets. Cruising at better than 300 mph over a 2100-mile range, the F-27 surrounds airborne executives with pressurized and air conditioned comfort. And no other aircraft of its type has the F-27's short-field capability.

FAIRCHILD
F-27

*For full information write to: R. James Pfeiffer, Executive Director of Customer Relations, Fairchild Engine & Airplane Corporation, Hagerstown 15, Maryland.*

THE FINEST AIRCRAFT FOR AIRLINES, CORPORATIONS AND MILITARY SERVICES

# Washington Roundup

## Thor the Winner?

Possibility is growing that the USAF-Douglas Thor intermediate range ballistic missile will go into production without any components marriage with Army's Jupiter. Defense Secretary Charles E. Wilson is scheduled to retire this week and leave announcement of the final decision up to his successor, Neil McElroy. In his Pentagon swansong, Wilson said last week that a marriage of the two systems would take more development time and delay deployment of the final IRBM. Wilson indicated that he and advocates of the "marriage" idea designed to salvage the best of the two missiles had overlooked the fact that the ground system equipment is both complicated and expensive.

The retiring secretary pointed out that less than 10% of the planned missile test firings have taken place and that the resulting lack of information combines with the task of appraising the ground system to complicate the evaluation job.

Major unanswered questions: If Thor is chosen, how much more money will be spent on Jupiter's development and who will provide it?

## Soviets' Satellite Secret

Russia intends to say nothing about attempts to launch a satellite until one has been placed successfully in its orbit. This is contrary both to International Geophysical Year aims and Russia's own previously announced plans.

Soviet delegation to the CSAGI Rocket and Satellite Conference here began last week by repeating earlier Russian statements that "sufficient" warning would precede launch attempts.

Russia has chosen 20.005 and 40.002 megacycles for satellite radio signals. U.S. delegates pointed out that this will require costly modification of U.S. Minitrack and other tracking stations and take several months time. Soviet Delegate Sergi M. Poloskov's evasiveness over contradictory statements about orbiting time of satellite and "sufficient" warning to other nations finally provoked laughter, in which Poloskov joined.

Later in the week, his delegation was saying there will be no pro-launching alerts. Any failures in attempted launches apparently will remain Russia's secret.

## CAB Ethics

Watch for the Senate Permanent Investigating Subcommittee to issue a report within the near future calling for legislation to spell out a code of ethics for members and staff employes of Civil Aeronautics Board and airline representatives. The report will be based upon hearings held last spring concerning an alleged CAB "leak" on the decision to award a New York-Miami route to Northeast Airlines (AW May 13, p. 43).

At the hearings, Raymond Sawyer, associate director of CAB's International Division, protested testimony by Laurence Henderson, sales representative of Fairchild Airplane and Engine Co., indicating that Sawyer was the source of an advance leak on the decision. At the time, Sawyer was executive director of CAB, and Henderson was Washington representative for Trans American Airlines.

Sen. Henry Jackson (D.-Wash.), who presided over the hearings on the Northeast case, already has introduced legislation establishing criminal penalties for both CAB employes who "leak" confidential information and for individuals who attempt to "pressure" Board members.

## Tax Collector Collects

Bureau of Internal Revenue plans to continue collecting taxes on the "free" transportation aircraft and other defense firms have provided new employes as an inducement despite a challenge by a U.S. District Court.

Most employes, it appears, are not aware that the cost of their move to a new location which is paid by this new employer, is taxable—until the Internal Revenue agent comes to collect.

The bureau's position, however, has been challenged by the U.S. District Court for the District of New Mexico. In two cases involving Sandia Corp., the Court maintained that Bureau of Internal Revenue collections of taxes on payments made by Sandia to lure employes from Kentucky and Texas were "illegal." The court said there was no intent on either the part of Sandia or the employes to have "the reimbursement constitute compensation." The employes, the court held, "received reimbursement only for actual travel and moving. . . . The relocation . . . was for the convenience of the employer . . . and did not constitute income in the hands" of the employes.

The bureau is appealing the decision to the U. S. Circuit Court of Appeals.

Meanwhile, its tax collectors will continue to demand tax payments on the transportation and moving expenses paid by employers.

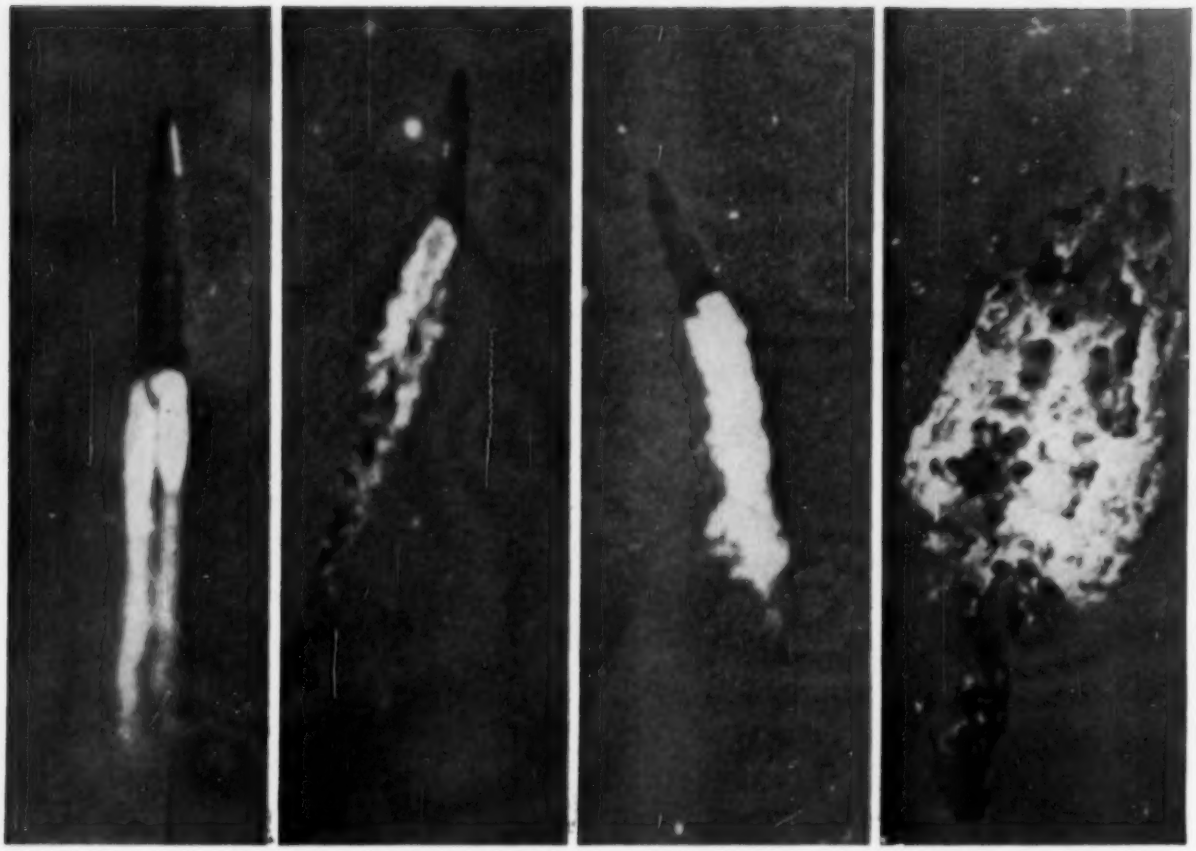
## Fare Discount Cut

Dropping of the 10% fare discount on military travel by eight airlines may be an indication that the agreement with the military will be eventually dropped. The Civil Aeronautics Board, which has never been enthusiastic about the discount, has ordered an investigation to determine the need for continuance of the discount provision in the Joint Military Air Transportation Agreement No. 5. An airline spokesman said it is doubtful that the eight would have withdrawn from the agreement if they felt the CAB would again approve the agreement since considerable military travel would then be diverted to airlines that continued the discount. The agreement was first executed in 1949 to narrow the gap between air and rail travel and attract more military travel on airlines. Now, however, rail fares have increased, and airlines claim the need for a discount no longer exists. Airlines who have formally withdrawn the discount are American, United, Trans World, Western, Bonanza, Mohawk, Los Angeles Airways and New York Airways.

## Airspace Control

Civil Aeronautics Board last week officially adopted an amendment to the civil air regulations that will establish control of airspace over the U.S. above 24,000 feet. The amendment will become effective on Nov. 1 (AW Sept. 30, p. 43). CAB's amendment is the first step of a comprehensive plan for improved and expanded air traffic control.

—Washington staff



**LATEST** Atlas firing from Cape Canaveral. The Convair intercontinental ballistic missile apparently was fired to gain engine performance data, for it carried sharp nose cone and probably was meant for destruction when power units finished job (AW Sept. 30, p. 30).

# Missile Watchers Pierce Patrick Secrecy

## Housewives, motel owners know what will be fired despite official pretense that all is shrouded.

By Evert Clark

**Cocoa Beach, Fla.**—Second test model of the Atlas I intercontinental ballistic missile lifted from its Cape Canaveral launching pad, roared to 15,000 ft., programmed over and was destroyed.

At a public beach seven miles to the south, reporters hurriedly tossed binoculars into their cars and raced for telephones.

Several miles north of the Cape, news cameramen began dismantling the telescopic-photographic equipment that had recorded the firing on film.

In the Pentagon and at Air Force Missile Test Center's headquarters on Patrick AFB, official announcements were made. They said only that "a missile" had been fired.

Newspaper accounts used the words "failed," "flopped" and "goofed" to describe what happened to the Atlas. They noted that the missile cost millions of dollars. They quoted Assistant Defense Secretary W. J. McNeil's statement that the expense of developing ballistic missiles to an operational state "will be a good deal more than double the cost of developing the first atomic bomb."

A few stories said Air Force and Convair, the missile's prime contractor, felt the firing was not all failure because the missile did some of what it should have done, and valuable technical data was gained. These reports were unofficial. Officially, neither Air Force nor Convair could dispute the "failed" reports because of security regulations.

### Open Secret

Type of missile to be fired, its name and the approximate date of launching had been a wide open secret for many days despite the security rules to the contrary. Even information about the objectives of this particular test was obtainable. Static firings of the Atlas engines a few days earlier had been visible from public rights of way for anyone patient enough to sit and watch.

A few months ago, the firing rate for larger missiles was less than one a month at Cape Canaveral. Now it is almost one a week.

Word of preparation for a big firing spreads rapidly up and down the sandy peninsula lying between the Banana River and the Atlantic Ocean, and for an obvious reason.

Work at the $360 million Patrick-Cape Canaveral complex directly concerns 15,000 military, civilian and contractor personnel. Indirectly, it affects their families, their neighbors, several surrounding Florida counties, air and sea traffic over a broad, fan-shaped area 5,000 miles to the southeast and hundreds of aircraft industry employes and military personnel stretching westward to the Pacific Coast.

An official release on the history of the Test Center states: "Because of the limitations imposed by security, very little can be said about the missiles that are tested at the center." But neighbors and motel operators and wait-

resses and housewives do not read news releases.

### Visible Preparations

Some indicators that "a missile" is to be fired are official. Red balls, visible from many miles at sea, are erected on 90 ft. poles at either end of the Cape on the day of a firing. If the firing is to be at night, red lights are used.

Two crash boats and three retriever boats put to sea on firing days from a dock a few feet from a public beach. Observers who make a profession or a sport of missile watching know the time it takes the last boat out to reach its station on the range. Newsmen often take their breaks for lunch on the basis of such information.

Hoods on permanent tracking-camera stations on the Cape and along the beaches are rolled back only a few minutes before a launch is to take place.

Unofficial indicators of a big firing are as numerous as systems for betting the horses and generally more reliable. Each player has a favorite.

"You watch the wives," one man said. "When they come out to the beach with the kids and the binoculars, you know they aren't here to get suntans. They've got those already. They come out here and sit on the beach and Boom! It goes and they get up and go home."

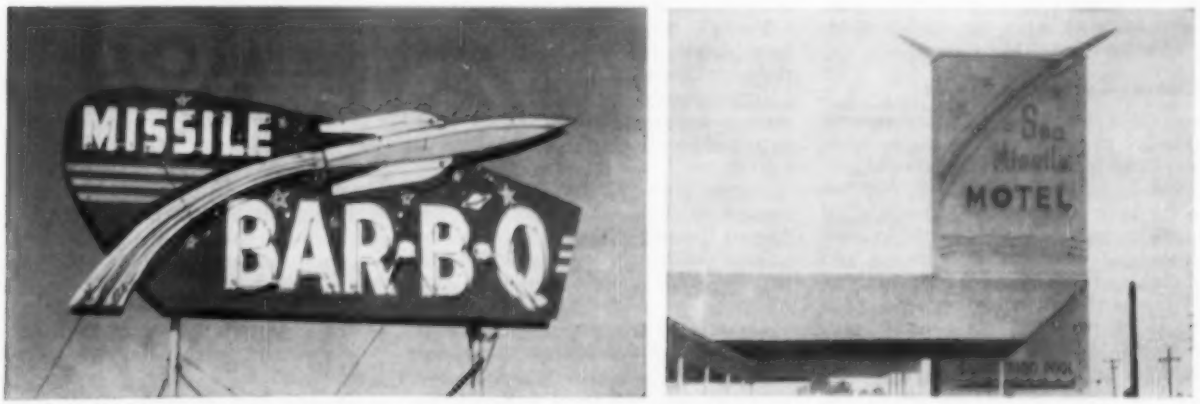
"You can tell when the motels begin to fill up with wheels, usually over a week-end," another said. "The big shots only come in here for a good one."

### When to Look

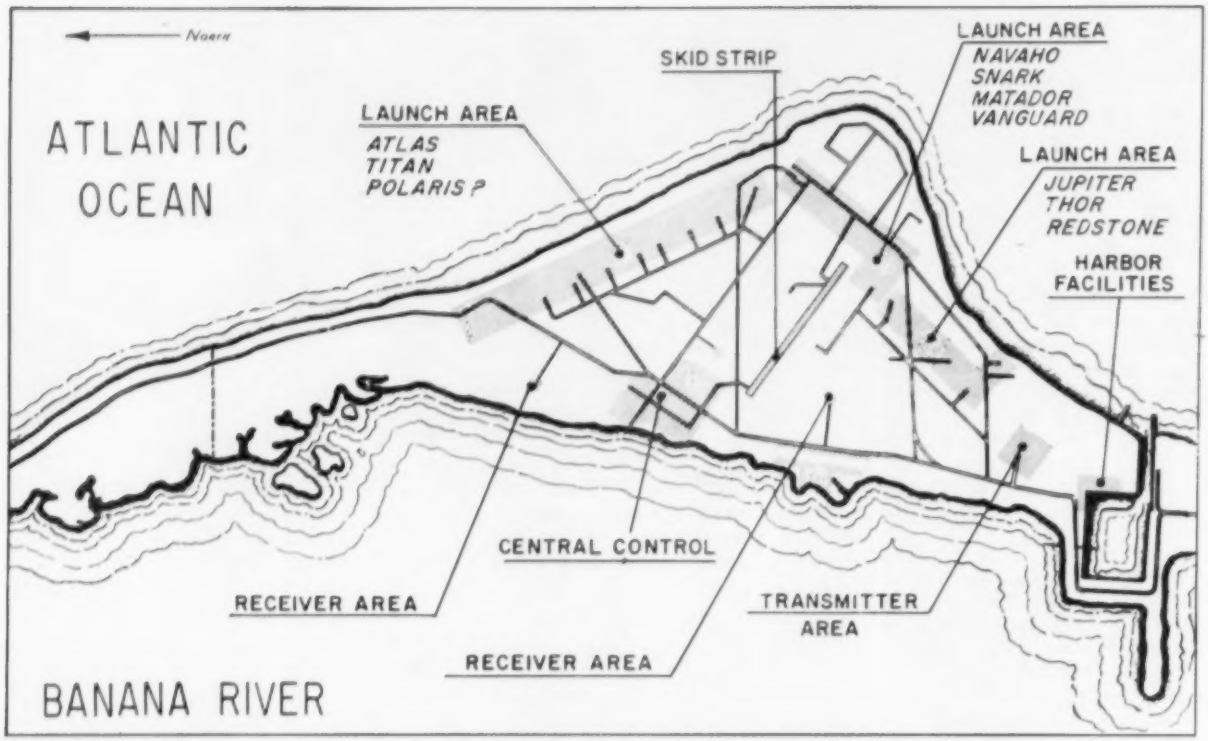
The simplest way to know when to go to the beach for "a good one" is to read the papers. Missiles have been big news to local reporters for some time—not so much because of a great technical interest in the science of rocketry or the strategy of war but because of the missile's impact on the

**HOUSEWIVES,** waitresses and motel owners are among the many knowledgeable missile watchers who come well-equipped to the sands of Cape Canaveral to witness firings. On at least two occasions newsmen have been questioned by security agents.

**MISSLE WATCHERS** intently focus on the launch area where rumor has it that a firing is about to take place. Everybody has a system for predicting launch time. The area is too large to be completely protected from the eyes of unauthorized observers.




**SIGNS OF THE TIMES** in the Cape Canaveral area indicate that the promotional value of missile test operations is high. Many of the area's residents disregard daytime firings since fiery effects are diminished by sunlight.




**MAP** of launching area at the Air Force's Missile Test Center on Cape Canaveral. Security protection is difficult.

day-to-day life of their readers. To some Floridians, it is the greatest thing since the Fourth of July.

A headline from an Orlando paper reads: "Sand Dunes Jammed When the Word is Whispered; Atlas Rumors Send Brevard (a county) to Cape."

Local reporters have devised many ways to tap the grapevine. Most are standard techniques for gathering information, techniques that existed before policy directives and specific regulations on missile security were conceived.

Occasionally, a technique more fitting to the art of missile snooping is employed—such as the portable shortwave radio with which one man tries to "sit on the frequency" used for communication between the crash and retriever boats and the Cape.

### Canvas-Covered Missiles

Trucks loaded with canvas-covered missiles, moving along the public highways and often travelling at night, are early harbingers of a firing, but too early to be useful.

Auto traffic along the single road from the motels, trailer courts and homes to the Cape is an index only of the general activity of the area. It is heavy all the time.

But an operator of a trailer camp or motel that houses contractor personnel notices when their hours seem long and irregular and makes an educated guess as to what is about to happen.

A group of missile-watching newsmen were sitting in the Capette Diner north of Cocoa Beach recently when they heard a muffled roar. A wire service reporter jumped from his chair and ran outside, afraid they had all been caught napping.

### Missile Bar-B-Q

"Every time our french fryer cuts in somebody thinks it's a missile," the waitress said. "But you should see them jump when the fan cuts on down at the Missile Bar-B-Q."

Many of the area's residents now bother to step outside only at night when they hear the roar that signals a launching. There is likely to be too little to see in the sunlight of day.

For all the techniques that have been developed for missile watching, there are of course counter-techniques. Security regulations are designed to prevent military personnel, civil servants and contractors' employes from talking.

Agents of the Federal Bureau of Investigation and Air Force Office of Special Investigations and contractor security police are always active, checking the usual sources constantly and observing the observers.

On at least two occasions newsmen have been detained and questioned for taking photographs too near the Cape itself. At the first night firing of the Army's Jupiter, which produced a turnout of holiday proportions along the beach, agents wrote down auto license tag numbers.

At least one Cape employe has been fired for speaking too freely over a telephone.

Professional missile watching of the type done by newspapers, magazines, wire services and newsreel cameramen is expensive in terms of manpower, money, time and patience.

Security is costly in the same terms and considerable sums are spent to maintain it here. Tighter security would mean more cost.

Those familiar with security problems in this area say many other factors work against a tighter control of information.

Physically, the Cape is accessible only by one road each from the north and south; from the river on the west and the ocean on the east; and by air.

### Security Expensive

But the area from which a firing can be seen and photographed is much broader. It would be impractical, prohibitively expensive and probably legally impossible for the government to acquire enough land to make the area absolutely secure physically.

So long as the land north and south of the Cape is not closed, press and public can be watched but not interfered with.

Greatest help to those who try to maintain security is the complexity of missiles and missile testing. Much

# Lack of Interest Stalls Missile Defense Programs

Washington—Army's Nike-Zeus and Air Force's Wizard anti-missile missile programs are lagging far behind schedule because of lack of high official interest and consequently lack of funds.

Translation of these "paper missile defense systems" into real defense weapons will take billions of dollars. Presidential policy of limiting information on the status of U. S. and Soviet missile programs has left Congress unprepared for this expenditure. Current status of major U. S. anti-missile missle programs is as follows:

• Nike-Zeus. Farthest advanced, Army's Nike-Zeus is an adaptation of Nike-Hercules. Contractors are Douglas for the airframe and Bell Laboratories for control equipment. Nike-Zeus has a presently-proposed range of 100-200 mi., but Douglas is attempting to improve this figure. Bell Laboratories has produced some hardware on the target acquisition, guidance and computer systems but radar being used is company's own relatively short range version, not the 3,000 mi. radar for missile defense mentioned recently by Gen. Thomas D. White, USAF Chief of Staff (AW September 30, p. 25). Informed sources say that Bell Laboratories for proprietary reasons is resisting switch to long range version. Initial guidance for the Nike-Zeus is provided by guidance radar and computer. System is lagging well behind schedule and is scrimping for funds.

• Wizard. Air Force Wizard system exists only on paper, no significant hardware has been produced. Contractors are Convair for the airframe and RCA for acquisition, guidance and computer. Proposed missile has planned range of about 1,000 mi., is solid fuel, and is not an adaptation of any existing missile. Basic difference from Nike-Zeus is in the different type of radar guidance provided for the missile. Although Air Force considers its system far more sophisticated than the Army's, program is far behind Nike-Zeus and far from completion of even the paper planning.

• Plato. Scheduled to be canceled as unpromising, Plato was initially studied competitively by Cornell Aeronautical Laboratory, and Sylvania, was given to Sylvania as prime contractor. Small amount of hardware has been produced. Plato has been supported by both Army and Air Force funds.

There have been several other study programs. Lockheed and Raytheon at present have an Air Force contract for an anti-missile missile study program. General Electric has worked on a system combining a modified GE early warning radar with a specially developed computer. Informed sources consider the radar lacks required range but computer as excellent.

With concentration of Army and Air Force on Nike-Zeus and Wizard, future for other systems appears dark. Navy is interested in an anti-missile missile for fleet defense but so far has confined itself to studying systems based on modifications of Talos shipboard to air missile.

Studies of the anti-missile missile problem have resulted in similar philosophy of defense both for Nike-Zeus and Wizard. Both are limited area defense systems designed to provide early warning of an incoming missile, acquire the missile as a target, track it to compute its trajectory, and then fire anti-missile missiles along the same trajectory to intercept and kill the intruding ICBM or IRBM with a nuclear or thermonuclear warhead.

Present approach is towards smaller, more maneuverable missiles with lighter warheads. This means that to insure a high kill probability between 10 and 20 anti-missile missiles will be fired against each intruder. Problem of much concern to those studying this problem is the large amount of fissionable material that will be required by such systems. Present U. S. capability for producing fissionable material is inadequate for the anticipated requirements. Some idea of the cost of these 10-20-missile systems can be gathered from the fact that the lightest nuclear warheads for this use will cost over $1,000,000 each in production quantities.

Seconds or minutes available between detection and arrival of an enemy ICBM or IRBM necessitate a fully integrated and highly automatic system. Because the presently planned systems are capable of defending only relatively limited areas, defense of major U. S. industrial, military and civilian centers will require a large number of such systems.

National interests may dictate U. S. supplying any missile defense system used in this country to its allies. NATO countries have already been threatened with nuclear oblivion from Soviet IRBM's during the Suez crisis and would not react favorably to U. S. policy of keeping for itself any system providing relative invulnerability.

Projected costs of development and production of any missile defense system are enormous. As the day when the Soviets possess a production ICBM approaches, the costs will probably be increased by the need for parallel and concurrent research, development and production.

technical information that is really valuable cannot be obtained without knowing precisely what was planned, what happened and why.

Only limited data can be obtained through binoculars or the lens of a camera placed miles away.

Greatest opponent of the security agent appears to be the attitude of the people directly and indirectly involved in missile testing here.

Thousands know at least one facet of the many operations at the Cape or in the long supply and communication lines leading to it.

There is no hot war, and talk is looser than it might be in other circumstances.

Lack of sympathy with an official information policy that prohibits identification of the missile fired or comment on its success or failure is not universal but it is extremely widespread.

It is shared by an appreciable number of officials of the services and the contractors whose missiles are involved and by most of the day-to-day workers, who read in newspapers what they have been warned not to say under penalty of loss of jobs or possibly prosecution.

Rapid growth of the area will increase the problem. There now are 15,000 military, civilian and contractor employes, representing a $6 million per month payroll. This is up from the 9,500 of just a year ago. By the end of 1958, the figure is expected to be 18,000—and there will be more housing developments like the Convair Cove, more Sea Missile Motels, more missiles at the Cape and therefore more to talk about or to keep secret.

A housewife who has never seen a missile before can arrive at the beach and learn in five minutes from eager volunteers what tower holds the Redstone, where the Atlas sits now that its 11-story test stand has been rolled back, and from what area the Thor is fired. If the wind and the information are right, she can learn the day and the approximate hour of a planned launching.

This does not give her intimate knowledge of the country's most vital defense secrets. But in the Cape Canaveral area this atmosphere does not encourage respect for information policies or strict adherence to security, either.

Missilemanship, or knowing and telling, is somewhat of a game that almost everyone seems to play and a player's score is determined by how much more he knows than the others.

# USAF Sets Monthly Expenditure Limits

By Claude Witze

**Washington**—USAF has assigned monthly expenditure limitations to 28 major contractors for the duration of Fiscal 1958.

The action appeared certain to force further stretchouts in production schedules, employe layoffs and a serious financial problem.

Major aircraft manufacturers at first glance estimated they will be forced to borrow sums running as high as $100 and $250 million each before next June 30 to finance their production lines under present schedules.

When these reactions were called to the attention of Defense Secretary Charles E. Wilson last week, he said these companies are being "stampeded" by the USAF order and that the expenditure ceiling "really is not the radical reduction people are saying it is."

Wilson said it is his opinion that the aircraft manufacturers have good credit at the present time.

### No Long Pay Delay

"It is not the Air Force's intention to have a big delay in payment of its bills for the rest of this year," he said, "but it certainly now expects to get some temporary help from the corporations. For them, it is going to be more like dealing with commercial customers, who need this kind of help from time to time."

USAF said the action was taken on top of previously announced cuts (AW Sept. 23, p. 29) to meet the insistent demand that the year's expenditures be kept within $17.9 billion. It was pointed out that this is only about 5% less than last year's outlay.

Major contractors were asked to submit their estimates of billings for the rest of the year. Each firm then was assigned tentative expenditure limitations. Wilson said this procedure was used to insure flexibility and give USAF the opportunity to deal with individual cases without the restrictions of an arbitrary slash.

### Production Adjustment

USAF Secretary James H. Douglas and Wilson said industry may have to adjust production schedules, but they expect renewed efforts to cut inventories and overhead.

At the same time, Douglas told the contractors in a letter they will be required to finance a higher percentage of the work in process out of their own funds. To this, Wilson added the possibility that a further reduction in progress payments will be made in the future.

Gen. E. W. Rawlings, chief of the Air Materiel Command, called for a statement from the contractors by Oct. 10, showing the cumulative monthly amounts to be paid on each major contract for the remainder of the fiscal year.

AMC then will provide a breakdown of how much it can pay each firm by individual contract.

Wilson said the program given to the industry by Douglas and Gen. Rawlings constitutes "the way the Air Force wants to do it." Other ways, he added, were to revise the delivery schedules downward by edict or to order the industry on a four-day week.

He said current employment in the aircraft industry is about 100,000 greater than it was a year and a half ago, indicating that he considers the industry payroll too large.

In addition to the prospect of layoffs, industry leaders were chiefly concerned last week with their financing problems.

In order to keep subcontractors in business and pay for the planned flow of materials, they anticipate running up substantial debts. Wilson said no provision will be made for the government to guarantee these debts or pay the interest they will incur.

### Industry Reaction

Industry observers, considered by Wilson to be over-excited by the prospect, saw two other important hurdles for their company comptrollers. One is the lack of ready available bank cash for loans of this type. A second is the possibility that banking interests will consider the loans a poor risk.

Early last week, executives of the major companies were taking stock of their prospects. Most important conferences were with their bankers.

It was clear that USAF and the Defense Department have taken the action in an effort to avoid any necessity for the administration to seek an increase in the $275 billion debt ceiling established by Congress. Washington pessimists, both in the Pentagon and outside, now believe it will not be possible to stay within the debt ceiling. There are some who believe Defense Department purchasing programs, particularly in the aircraft field, will suffer further hardships. Congress is not expected to take action against the trend.

## Where Expenditure Limits Hit

**Washington—Following is the list of 28 major contractors assigned monthly expenditure limitations by USAF for the remainder of Fiscal 1958:**

- **AC Spark Plug Division, General Motors Corp., Flint, Mich.**
- **Aerojet-General Corp., Azusa, Calif.**
- **Allison Division, General Motors Corp., Indianapolis, Ind.**
- **Beech Aircraft Corp., Wichita, Kan.**
- **Bell Aircraft Corp., Buffalo, N. Y.**
- **Bendix Aviation Corp., New York, N. Y.**
- **Boeing Airplane Co., Seattle, Wash.**
- **Cessna Aircraft Co., Wichita, Kan.**
- **Collins Radio Co., Cedar Rapids, Iowa.**
- **Convair Division of General Dynamics Corp., San Diego.**
- **Curtiss-Wright Corp., Wood-Ridge, N. J.**
- **Douglas Aircraft Co., Santa Monica, Calif.**
- **Fairchild Engine & Airplane Corp., Hagerstown, Md.**
- **Federal Telecommunication Laboratories, Nutley, N. J.**
- **Aircraft Engine Division, Ford Motor Co., Chicago, Ill.**
- **Hughes Aircraft Division, Hughes Tool Co., Culver City, Calif.**
- **Military Products Division, International Business Machines Corp., New York, N. Y.**
- **Lockheed Aircraft Corp., Burbank, Calif.**
- **The Martin Co., Baltimore, Md.**
- **McDonnell Aircraft Corp., St. Louis, Mo.**
- **Western Electric Co., New York, N. Y.**
- **General Electric Co., New York, N. Y.**
- **North American Aviation Inc., Los Angeles, Calif.**
- **Northrop Aircraft Inc., Hawthorne, Calif.**
- **United Aircraft Corp., East Hartford, Conn.**
- **Radio Corp. of America, New York, N. Y.**
- **Republic Aviation Corp., Farmingdale, L. I., N. Y.**
- **Sperry Gyroscope Co., Great Neck, L. I., N. Y.**

## Employment Cuts

**Washington—Additional job reductions totalling 5,200 and pre-dating the writing of Air Force Secretary James Douglas' letter setting monthly spending ceilings have been announced by North American Aviation Inc., and General Electric Co.**

**North American's Columbus Division will eliminate 3,200 jobs by attrition and layoffs by the end of next March. Total at mid-year was 15,786. Total by the end of March is expected to be 9,500. Production of the USAF F-100D and the Navy FJ-4 and T-28C will phase out in the next few months. Navy's T2J and A3J are in tooling and preproduction stages at Columbus. The division also has entered promising Navy, Marine, USAF and Army competitions and "is concentrating considerable effort in various commercial fields," North American said.**

**General Electric's Aircraft Gas Turbine Division at Evendale will cut 1,800 jobs in its production engine department and 200 in the flight propulsion laboratory within a few months. Production engine department had approximately 9,000 employes at mid-year, and the laboratory had 2,300 (AW Aug. 5, p 26).**

At his last press conference as chief of the Pentagon, Wilson reported that department expenditures in September —the critical month—were about $3.3 billion for regular functions and the Military Assistance Program. This is down from $3.44 billion in July and $3.66 billion in August.

Wilson said his preliminary estimate of expenditures for the first quarter of the fiscal year will be close to $10.4 billion or $300 million more than planned. He commented that the September rate was encouraging: "We lost no more ground in September and maybe gained a little."

Actually, the September rate was at about the $38 billion level set for the year. It follows that outlays for the rest of the year must decline still more.

## Aeronutronic Expands

**Aeronutronic Systems, Inc., Ford Motor Co. subsidiary, has begun expansion from its temporary quarters in Glendale, Calif., acquiring a 100-acre site at Newport Beach near Los Angeles with option on an adjacent 100 acres. Construction will begin at once to house an integrated installation for avionic and materials laboratories, weapons engineering activity and prototype manufacturing of avionic equipment and possibly missiles. Aeronutronic is moving fast to become established at its new location in order to support a particular project.**

# French Aircraft Industry Gains Threatened by Drastic Cutbacks

By Robert Farrell

**Paris**—French aircraft industry is threatened by important budget reductions which will result in severe cutbacks and cancellations of current production models as well as complete abandonment of several advanced prototype aircraft.

Budget reductions are being imposed as result of French efforts to pare as much government spending as possible. Reductions are being imposed despite frantic industry arguments that such action will just about wipe out most of the progress made by industry over past decade, progress acclaimed by aviation world at the Paris air show in June.

### Still Unofficial

Reductions, which were accepted by Army dominated French Defense Ministry last August, are not yet official. Recent fall of French government leaves issue hanging, with observers pretty well divided in opinion as to whether new government will push for same cuts.

According to informed opinion, present beefed up production on such models as Sud Aviation Djinn and Alouette helicopters will be slowed down by an average one third. Same thing is predicted for Sud Aviation Vautour, Dassault Super Mystere and Nord Noratlas transport.

This comes just as French industry is beginning to lick its old problem—getting high production rates in order to lower unit costs. Government budget cuts are going to wipe out such progress. For example, Nord company presently is reaching monthly production rate of 10 with its Noratlas cargo transport. Under new schedule company will be required to slow down its line to about three aircraft per month. This will raise unit costs on future Noratlas aircraft and make it difficult for company to sell the aircraft abroad.

It also is understood that on Vautour and Super Mystere orders, budget cuts not only provide for stretching out production line but also for reducing orders. Orders on both these aircraft were initially cut back earlier this year.

Construction of 15 four engine Breguet 765 Sahara heavy cargo transports, new military version of Breguet Provence cargo passenger aircraft, will be stopped under budget drive. This decision was made despite fact that four of these aircraft already are in advanced stage of construction and in fact company presently is completing a brand new plant at Biarritz for final assembly of Sahara. Breguet officials estimate that as a result of the cutback, unit cost of the four aircraft nearly completed probably will equal total cost of whole 15 aircraft. Only recently Air Force described Sahara as ideal cargo aircraft for French Union mission.

All preproduction and production orders for ground support "police planes" for use throughout French Union are canceled under the budget reduction plan. This decision hits new projects like SIPA 1100 and Morane Saulnier 1500, models of which were displayed for first time at recent Paris air show. Also eliminated are older projects like Potez 75 and Morane 733.

Budget cuts on the Trident and LeDuc program may be tantamount to the abandonment of such projects. Also eliminated is Sud Aviation's new supersonic bomber Super Vautour which presently is nearing prototype stage. The original preproduction order for 20 Tridents has been cut back to six. This move against Trident comes as no surprise. For some time French Air Force has been showing preference for Dassault Mirage III rather than Sud Aviation rocket jet powered Trident intereceptor. Cancellation of Sud Aviation top secret supersonic bomber, the Super Vautour, has jarred French industry circles on the other hand. This move is being interpreted as another victory for Dassault, as latter company has supersonic bomber, Mirage IV, in prototype stage. Latter aircraft remains untouched by budget cuts.

### Design Group

Possible disappearance of the Trident project plus elimination of Super Vautour has thrown a cloud over the famous design and research body at Courbevoie near Paris. This group is run by Sud Aviation but is more or less financed by Air Ministry. Responsible for such projects as Trident and Super Vautour, the group at Courbevoie may nevertheless be disbanded.

Another shock for French aviation circles is the blow aimed by budget cuts at LeDuc ramjet program. First LeDuc 022 ramjet is already flying with second almost 75% completed. Company has been told it probably won't be able to complete the second prototype.

As for missiles, present budget cuts appear to leave old projects standing untouched. Same is true for Sud Aviation Caravelle. Though not ordered by military, it still needs government support in order to get production rolling.

# Disillusioned Military Contractors Now Enter Business Plane Market

By Erwin J. Bulban

Denver—The aviation industry's awareness of the lucrative potential of business flying market was preponderant theme at National Business Aircraft Assn.'s 10th Annual Meeting and Forum here last week.

Trend in evidence here is that business flying pie will no longer be sliced by a relatively few specialist firms as in the past; these will face continually mounting competition in the next few years by many manufacturers hitherto solidly committed to military and airline requirements.

### Military See-Saw

Underlying comments on the general display was feeling of many manufacturers, some showing business aircraft equipment for the first time, that their firms no longer could tolerate U.S. see-saw military programs. Realization that higher profit margins and marked reduction of red tape in negotiating private aircraft and equipment sales are also key factors in increasing the competitive factor in business aviation manufacturing.

Among active new participants at NBAA meetings were Grumman Aircraft Engineering Corp. and its recently named distributors (AW Sept. 30, p. 29). Some 18 Grumman Dart-turboprop-powered Gulfstream transport positions are currently scheduled for the Bethpage, N. Y., production line, comprising three static and flight test models and 15 aircraft for firm's distributors. Current negotiations indicate that this will be expanded to include 27 airplanes. According to one distributor, inquiry regarding deposit recently was made by a West German firm.

Another new face was Aircraft Marine Engineering Corp. which trucked a full-scale wooden mockup of its Anser twin-turbofan-powered business amphibian from the West Coast. Interest in this project is very "encouraging," according to Acme, which recently completed a sales tour covering Canada.

New aircraft and mockups were spectacularly displayed in the street-level concourse of Denver's ultra-modern mile-high center.

Indoor static displays included:

• **General Electric** lightweight compass system, displayed for first time, marked the company's entry into the business aircraft equipment field. Based on GE's G-2 military counterpart, the new compass features an electrically driven panel-mounted gyro. Operating on 24 watts of 115v. 400-cycle three-phase power, the unit is reported to have a maximum error in heading in the slaved mode never exceeding two degrees and to be operationally stable up to 40,000 ft. Free gyro drift rate is said to be four degrees ten minutes.

Weighing eight pounds, the equipment will sell for about $1,500. GE says it can make 30-day delivery. Company appointed Wilcox Electric to handle distribution.

• **Infrared Proximity** warning system mockup was shown by Aerojet-General. Equipment, weighing 30 lb. installed, is scheduled for installation in the company's DC-3 for demonstration to Air Transport Assn. and Flight Safety Foundation. Hemispherical coverage is given as 800 ft., range as 2-4 mi. According to Aerojet-General based on a survey of CAA mid-air collision analyses, its proximity warning equipment would have provided a minimum warning of 20 sec. in more than two-thirds of the collisions. Pilot production of equipment probably will start in December or January.

• **Stratos Division** of Fairchild displayed its S-20 cabin supercharger system providing approximately 25 lb./min. airflow and specifically designed for cabin pressurization of small business aircraft. One light twin manufacturer is flight testing the installation.

Collins Radio is preparing a complete line of navigation and communications equipment for a new market for the company, from the light twin down through single-engine business planes, according to informed observers here. Some of this new equipment, not displayed, is expected to start reaching the market early next year.

### Turboprop Marksman

Another new turboprop-powered business plane, the On Mark Engineering Marksman, to be powered by two Allison 501-D21 engines turning Aeroproducts 606 propellers, is expected to make its first flight next May or June, a company spokesman told Aviation Week. Tooling is about 80% complete, fuselage of number one airplane is expected to be completed by Christmas. On Mark has two firm orders for the Marksman, one for Maytag and a recent one from Phillips Petroleum.

Allison 501-D-21 is a revised version of the D13 on the Electra; it features gearbox offset down from above the engine to underneath. The 14-passenger executive transport is designed to be completely self-sustaining of ground equipment. An 85-hp. Porsche engine in the left engine nacelle is fitted with a Vickers pump to supply 3,000 psi. pressure to start the engines. The auxiliary powerplant will also provide electrical power on the ground and static ground air conditioning for the cabin. In event of a mid-air electrical failure, it can be re-started to bring back electrical power.

Two AiResearch superchargers, one on each engine, will supply cabin pressurization. They use the same compressors as on the units going into the Lockheed Electra.

Civil Aeronautics Administration will have a type board meeting on the Marksman configuration, including engine layout, Oct. 9.

Tip-tanked wings will be hot-air deiced using engine compressor bleed. Engine inlet ducts and tail will be electrically de-iced. Passengers will use a folding stairway just behind the cockpit to enter the airplane.

Interesting sidelight on the Marksman will be the company's use of a Lockheed 1649 Super Constellation nose section to form the new airplane's nose section, including flight deck, from behind the pilots' seats forward. On Mark will buy these 1649 noses from Lockheed at least for the first few production airplanes, modifying windshield to conform to CAA requirements for the Marksman.

Marksman will be priced at approximately $1.2 million each with complete interior, minus electronic gear, but including cost of installing this equipment to the customer's order. On Mark expects to be turning out two airplanes a day in 1959.

Allison is showing solid interest in the business flying field by providing close engineering support to the On Mark program. Company's interest extends beyond the big 501-series turboprops; a project for an 85-lb. 250-shp. lightplane turboprop is in the mill at the General Motors Aircraft Engine Division, Aviation Week learned; go-ahead on this project awaits a management decision.

Lockheed CL-329 Jetstar transport could not be shown at the NBAA meeting because of need for maintaining its flight testing. The airplane already has some 20 hr. flight time and has climbed with one of its two Bristol Orpheus engines out at 500 fpm. Lockheed aims to hand it over to USAF for Phase 2 testing in December.

Designer C. L. Johnson is enthusiastic about the performance of the 4,850-lb.-thrust turbojets and is favoring this installation over the original planned layout of twin General Electric J85s on each side of the fuselage, informed sources say. Lockheed will offer the airplane with both powerplant configurations.

# Missiles Won't Alter USAF Role—Irvine

By Russell Hawkes

**Los Angeles**—Long-range ballistic missiles do not alter the defense roles assigned to the three military services, USAF's Deputy Chief of Staff Materiel, Lt. Gen. C. S. Irvine told the Society of Automotive Engineers National Acronautic Meeting last week. Irvine called the IRBM and ICBM advanced air weapon systems but said they do not revolutionize the U. S. concept of military strategy.

USAF, as airpower specialist in the defense establishment, has been assigned responsibility for both IRBM and ICBM and must determine the best ratio of missiles to manned aircraft for each time period in the future. Irvine based his belief that "the flying Air Force will be the nation's primary deterrent force for as far into the future as we can see" on grounds that:

- **Some strategic targets** cannot be entirely destroyed by long-range missiles.
- **Countermeasures or unexpected defenses** cannot be evaded by most missiles once launched.
- **Bomb damage** cannot be properly assessed by unmanned aircraft.
- **Air defense missiles** cannot handle identification missions.
- **Full area defense coverage** cannot be given by air defense missiles in their present state of development.

### Stockpile Valuation

Irvine attacked the idea that industrial potential has any value as a deterrent to war fought with nuclear weapons. He said the only useful production is that completed before the first bomb is triggered. From that standpoint, the U. S. has the advantage of more highly mechanized production, meaning more output per man-hour, but as the amount of "customizing" necessary is increased and as fewer copies of a given system are produced, we tend to negate own advantage. This can be offset by better management and shorter design to inventory time.

Irvine pointed out that in the development of aircraft and long-range missiles, the Soviets have had the advantage of being able to concentrate on the ICBM and the long-range strategic bomber rather than having to diversify their efforts to include shorter range strategic missiles and aircraft. This advantage is the reverse of this country's advantage in having overseas bases close to Russia's industrial centers. The Russians are compelled to have long-range missiles and aircraft to strike the United States while USAF must have a variety of weapons to claim the advantage of advanced bases.

Value of a nuclear powered logistic support aircraft for USAF overseas bases was explained in technical sessions by Robert W. Middlewood and Robert B. Ormsby, Jr. of Lockheed Georgia Division. They said an airborne logistic system with chemically powered aircraft capable of supplying overseas Strategic Air Command bases would need surface fuel shipping with capacity equal to its own. This would constitute two major logistic operations: an air transport network carrying military cargo and a surface tanker fleet carrying fuel for the aircraft.

### Fuel Considerations

Obvious inefficiency of such an arrangement means that chemically powered aircraft can provide the necessary airlift only if adequate fuel can be stockpiled at overseas bases in advance. This is too costly to be done in peacetime. Also, since the range of chemically fueled aircraft is limited to about 3,500 mi. with full payload, bases beyond that range require intermediate fuel stops which are usually on foreign soil where wartime availability is problematical.

A nuclear powered logistic aircraft is independent of these factors because its range has no significant limitation. The authors envision an air logistics system able to carry all of the normal equipment of a unit being airlifted, rather than one capable of supplying only very high priority goods.

Some normally required items in a modern military operation weigh from 25 to 50 tons. This fact establishes the minimum payload acceptable in a truly satisfactory logistic aircraft design.

Utility of a nuclear cargo carrier depends on whether:

- **Existing airfields** can be used.
- **All types of cargo** can be carried.
- **Complicated ground-handling** facilities can be avoided.
- **Performance is comparable** to chemically powered aircraft.

To be practical, a nuclear transport must have as good crew utilization as a chemically powered aircraft. That is, crew flight time must be set by fatigue considerations rather than radiation dosage limits. This is a critical design factor because human beings can tolerate only 1/10,000 the radiation of the next most sensitive items, transistors and glass.

While the weight of chemical fuel is an important factor in aircraft design, the weight of nuclear fuel is insignificant. Important propulsion system weight in a nuclear aircraft is in the shielding.

Unlike chemical fuel weight, shield weight is not proportional to the total heat release needed.

Gamma rays and free neutrons, principal types of radiation near a reactor, require different shielding materials. Best yield against neutrons is hydrogen. Difficulty of handling liquid hydrogen dictates use of high hydrogen content materials such as polyethylene, water or gasoline. Best shield against gammas are dense materials such as lead. Paradoxically, materials having the highest specific gravity make the lightest shields.

Since radiation intensity decreases with the square of distance, divided shield with part of the shielding material around the reactor and part around the crew compartment is attractive from the weight standpoint. Best division for crew protection with minimum weight would leave radiation levels high outside the crew compartment, endangering ground crews, cargo and materials in the airplane itself. Since air crew is most subject to radiation damage, a good compromise must put enough shielding around the reactor to protect everything which is less critical. Radiation level can be further reduced to crew tolerance levels by crew compartment shielding to claim weight advantage of division.

### VTOL Characteristics

Performance and operating characteristics of convertiplanes were discussed by R. L. Lichten of Bell Helicopter. He pointed out that it is very possible that more than one form of VTOL configuration between the helicopter and the vertical lifting high speed jet will find practical applications because of special performance requirements.

Marked increase of installed power required, hovering fuel rate and downwash velocity was reported with increased disc loading. Cruising range was found to be better with low disc loadings while speed capability increases with disc loading. Speed capability for equal installed power was largely independent of disc loading.

Speed increase from helicopters to convertiplanes was attributed to the disappearance in the latter of helicopter speed limitations due to retreating blade stall and advancing blade compressibility losses in high speed flight. This is eliminated because plane of rotor-propeller of convertiplane in forward flight is perpendicular rather than parallel to line of flight. Speed jump from convertiplane to direct lifting jet is due to addition of heat to propulsive fluid, resulting in an increase in thrust.

Helicopter retains an advantage in static lifting efficiency because of low rate of energy dissipation in slip-stream.

# Traffic Control Experts Loaned To Airways Modernization Board

By Philip J. Klass

**Washington**—First details on organization of the Airways Modernization Board and the new agency's progress to date were reported here at the fall assembly meeting of the Radio Technical Commission for Aeronautics by James L. Anast. Anast is acting technical director of AMB.

Airways Modernization Board staff now numbers around 50, of which about 30 are professional personnel. Board expects staff to reach 60 within several months, ultimately to grow to about 100, excluding persons required to operate agency's proposed experimental facility, Anast said.

Airways Modernization Board has been able to obtain some of nation's top traffic control experts from military and civil agencies on a temporary duty assignment basis. To allay any fears that the agency will go overboard on technical developments without adequate consideration of user needs, Anast said that present staff includes six traffic controllers, three licensed private pilots, six military pilots and two airline pilots.

### First Project

First of the Airways Modernization Board's programs, officially launched last week, is assembly of an experimental automatic data processing and display system, using existing state-of-the-art, for delivery in January 1959 (AW Sept. 30, p. 29).

Next AMB program to be initiated will deal with airport configuration research. Agency is drawing up a program of analysis and flight experimentation to be conducted during next 12 months to provide data for design and construction of high-speed turnoffs and associated lighting, Anast reported. This crash program later will be expanded into full airport configuration research program which will include parallel runway locations, parallel short runways for private aircraft use, by-pass strips and optimum locations and configuration of adjacent airports, Anast said.

### Board's Organization

Airways Modernization Board's efforts will be carried out by four line organizations:

- **Operations analysis branch** will conduct continuous measurement-analysis program in the field to determine where specific airways facilities improvements are needed and to forecast user requirements. This will pinpoint areas where research and development activities are required.
- **Systems analysis branch** will analyze new systems proposed by user groups, avionics manufacturers, or by an AMB Systems Engineering Group consisting of senior personnel from all branches, to evaluate and select the more feasible ideas.
- **Systems experimentation branch** will plan and direct evaluation of the more promising new systems recommended by the Systems Analysis Branch. Tests will be conducted at proposed AMB experimental facility, at military or civil agency facilities, or at an outside contractor's plant.
- **Component development branch** will provide pool of technical experts in various skills required for developing new aviation facilities. This group will direct AMB contractors in their development programs, will also closely monitor Defense Department developments to be sure that new state-of-the-art is quickly applied to the Common System, and to prevent or quickly resolve Tacan-DME-type conflicts.

### Direct Contact

User groups that want to introduce their formal requirements to AMB "will be able to do so directly without having their policies and desires filtered through a series of panels and committees," Anast said. When AMB needs to coordinate matters of interest with user organizations, "it is expected that the Board will confer directly with officials of these organizations," Anast said.

New agency expects to manage its own research and development program without outside assistance, Anast said. However, to keep the management workload to a minimum, AMB plans to award only a limited number of contracts for major segments of its entire research and development program.

## Infrared PWI Tests

**Four major airlines plan flight test evaluations of new Aerojet-General infrared aircraft proximity warning indicator, beginning early in 1958 (AW Aug. 12, p. 77). United Air Lines will install the system on a Convair 340, Pan American on a DC-7, American on a DC-7C, and TWA or Eastern on a Constellation. Aerojet-General expects to begin initial flight tests on company DC-3 in November.**

## 'Explosive' Helicopter Growth

**Washington—Forecasts of an "explosive" growth in civil helicopter traffic between 1961 and 1965 makes it imperative that the traffic control problems be tackled immediately on all fronts, the Radio Technical Commission for Aeronautics has been warned by Don R. Berlin, president of Vertol Aircraft Corp. and the American Helicopter Society.**

**Predicting 30 million rotary-wing traffic movements on civilian airports by 1965, Berlin said a third of these will be made by air carriers. The airline takeoffs and landings, he said, will be 50% greater than all domestic air carrier operations in 1956.**

**Berlin called for formation of a committee, including representatives of federal, state and local governments as well as industry, to spur quick action on navigational aids and special Civil Air Regulations.**

**The committee, Berlin said, will have a big assignment, and he suggested that the scheduled airlines take the initiative in forming the group. He said the carriers will be able to buy turbine-powered transport helicopters, with double the ton-mile capacity of today's rotary-wing aircraft, in the period of 1959 to 1961. He said the industry expects there will be 800 transport helicopters in airline service by 1965.**

# Ramey Tells Industry To Stress Simplicity

**Fort Worth**—Military airpower planners and the aircraft industry must strive for solutions to problems of the future which accomplish necessary performance with a degree of simplicity that will allow a feasible cost level, according to Lt. Gen. Roger M. Ramey (USAF, Ret.).

Gen. Ramey, who retired as vice commander of the Air Defense Command in January, said that both Defense Department and industry must acknowledge that the greatest technological advance must be reckoned, not in terms of advance, but in terms relative to costs. "Proper military planning means the proper balance between defeat and bankruptcy," Gen. Ramey told a meeting of the Texas section of the Institute of the Aeronautical Sciences.

Pointing out that costs are increasing rapidly with advancing technology and performance requirements, Gen. Ramey observed that new developments are being exploited principally to achieve higher performance. He said

# CONVAIR JET 880

*Fastest... Finest... for the new jet age!*

*Fastest* at 615 miles an hour, the Convair Jet 880 also is designed in every detail to lead the way in luxury. With exciting new interiors by world-famed designers and Convair's traditionally excellent engineering, the 880 assures you the *fastest... finest* air travel *in the new jet age.*

**CONVAIR**

A DIVISION OF GENERAL DYNAMICS CORPORATION

Among airlines to first offer Convair 880 Jet-Liner service will be

**TWA • DELTA**

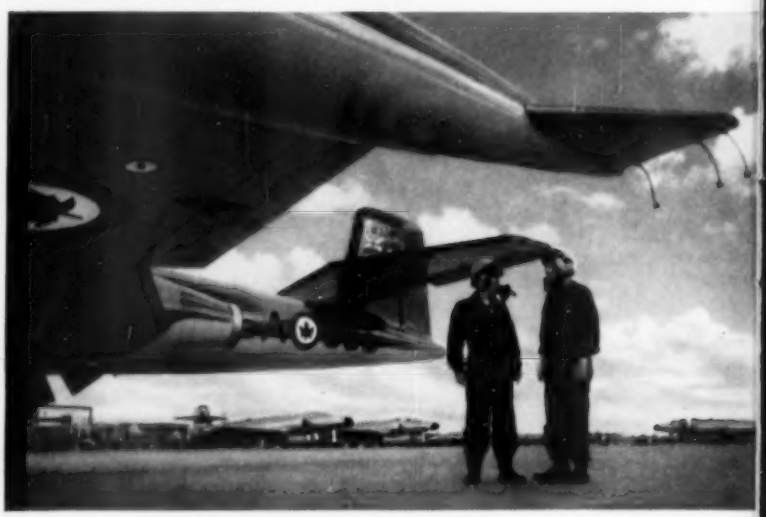
**TRANSCONTINENTAL, S.A.** *(Argentina)*

# IN SUPPORT OF FREEDOM

Four Royal Canadian Air Force squadrons of CF-100s are now in service with NATO in Western Europe. Once again Canada has demonstrated its capability of meeting its commitments to its allies in defence of freedom, on schedule.

Additional squadrons of CF-100 interceptors have been ordered to augment the all-weather, round-the-clock defences of Belgium.

*An R.C.A.F. Squadron parades before take off to base in Europe.*



*Pilot and navigator team-up for trans-Atlantic flight.*

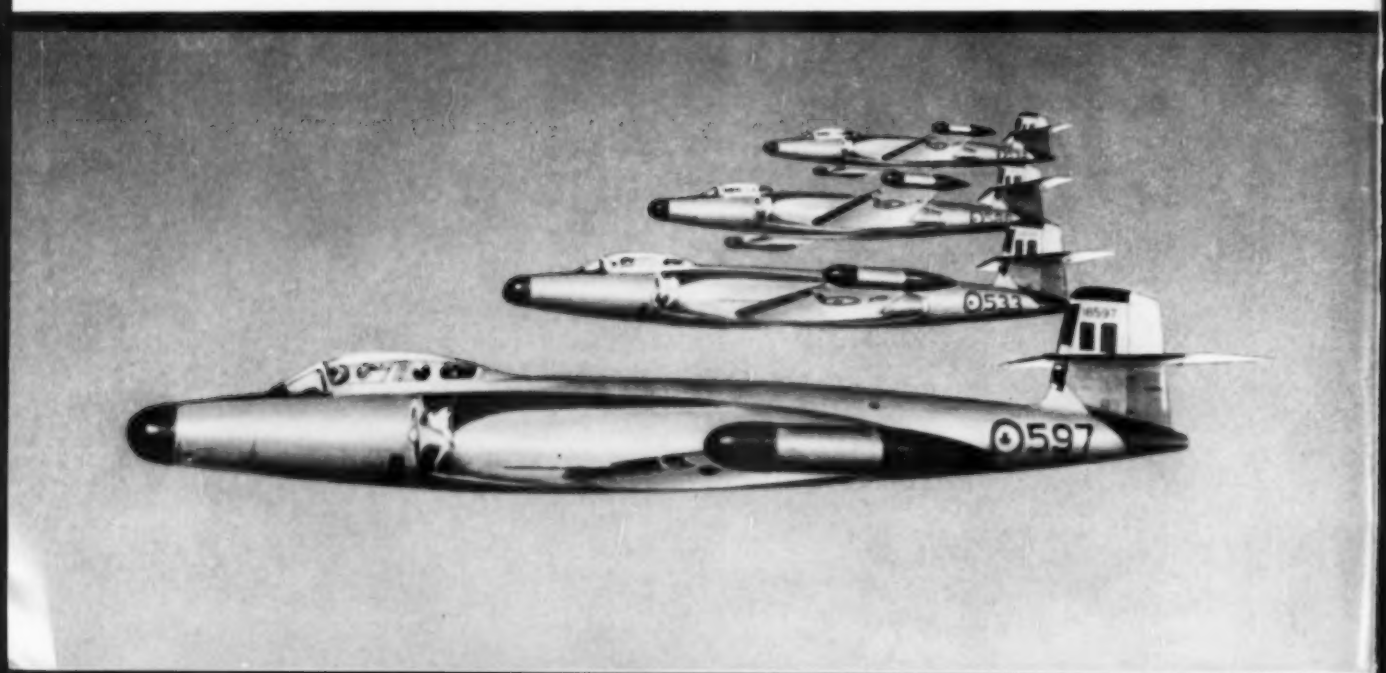
AVRO AIRCRAFT

**AVRO AIRCRAFT LIMITED**

MALTON, CANADA

MEMBER: A. V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP

*Formation flight of rocket-armed CF-100s.*



that, if all weapon systems for which there may be a demonstrable requirement and which are technically and scientifically feasible, are carried through to procurement and operation, total defense costs will mount at an explosive rate.

Some restraints must be imposed, Ramey said, since, if the capacity of the national economy is charted to finance the defense effort and this chart is compared to the scale of rapidly rising costs, a tremendous deficit then results.

Gen. Ramey observed that, in the future as well as right now, some feasible solutions to defense problems will have to be deferred, stretched out or discontinued.

Gen. Ramey, now a Fort Worth insurance executive, suggested four areas in which the aircraft industry could contribute to solving these problems. First, he said, is in the field of guided missiles.

For certain missions, missiles offer the best means of delivery, although Gen. Ramey emphasized his view that missiles can not wholly replace manned aircraft, at least in the present state of the art.

For targets whose location is known, Gen. Ramey said long range missiles like the Northrop Snark offer the lowest cost means of delivery. Costs also are cut by development of air defense missiles which "cut down some of the extremely costly high performance demanded of the fighter."

Modernization of weapon systems is another potential field for cutting costs, Gen. Ramey said. As weapon systems become more costly, the nation can afford to bring fewer and fewer of them into operation, and one way to avoid falling behind in the technological race is to design growth potential into a weapon when it is first under development, he said.

Third suggested area for cost cutting effort is "establishment of and emphasis on a broad scientific and technological base for operation." Gen. Ramey said two examples of the results of such an approach are increased thrust weight ratio in the new small jet engines now under development and boundary layer control.

Gen. Ramey suggested that the fourth area for cost cutting lies in the use of science and technology to find simplified solutions to defense problems.

It is the final increment of performance that results in disproportionately large increases in complexity and cost, he said. By utilizing state of the art techniques to simplify, for instance, "it may be possible at a reduction of only, say, 5% unit effectiveness to realize a savings of from 40 to 50% in unit cost."

# Technical Merit of Navaids Bows To Pride, Politics in ICAO Talks

By James A. Fusca

**Montreal**—Pride, politics and commercial competition are dominating discussions here of both long and short range navigation systems, blocking possibility of implementation of any system internationally in the immediate future. Discussions are part of sixth Communications Division meeting of the International Civil Aviation Organization.

Basic conflict is between Great Britain and U.S. over philosophy of area coverage versus rho-theta systems. British, with strong support from other commonwealth delegations, are pressing for an early international conference to evaluate available systems for both long and short range navigation. Reason is that British Decca short range aid is presently in use and Dectra long range aid is expected to complete trials within the next nine months (AW July 15, p. 73).

## U. S. Viewpoint

U.S. delegation is resisting any move for an early international conference because domestic evaluation of the three long range, ground based systems it has presented—Navarho, Loran C (Cytac) and Omega—is not expected to be finished for three to six years.

In short range aids, U.S. is supporting the previously adopted VOR/DME standard with proposed modifications to the DME (Distance Measuring Equipment) signal specification to make it compatible with Tacan (DME-T). With this modification, U.S. Vortac system would comply with ICAO's VOR/DME standard.

British position on both long and short range systems has been given in a working paper presented to the meeting which states:

"It seems quite clear that the time has come when the entire question of navigational aids must be completely reviewed in order that a solution may be found which will adequately meet the urgent problems of the high performance aircraft. . . .

". . . The United Kingdom recommends most strongly that a special meeting of ICAO be convened, at the earliest possible date, to give this matter the consideration it demands."

Committee studying long range aids is expected to adopt a proposal of the Australian delegation to pass the problem of how and when these systems will be evaluated to ICAO's permanent Air Navigation Commission, and to ask the commission to determine urgency of implementation. If this is done, U.S. is expected to carry on its fight against an early meeting through its representation on the commission.

Implied U.S. viewpoint on short range aids is that the expanded Vortac program is adequate to meet all immediate problems of U.S. domestic jet operations. Across the North Atlantic and other high density, long haul routes, improved communications through planned forward scatter nets plus improved ground-air communications are believed to be capable of providing adequate air traffic control for the period that it will take to develop, evaluate and implement a satisfactory long range aid.

Observers present from two other international organizations have stressed the urgency from their points of view of an early solution to the long range aid controversy. A representative of the International Telegraph Union told the subcommittee considering the long range aid question that it might take up to five years to clear any band of frequencies—for example, the 90-110 kc. band used by Navarho and Loran C (Cytac)—on an international basis.

The International Telegraph Union representative said that if a decision as to frequencies required was made in time, it could be brought before the July, 1959, meeting of ITU, but that the next international meeting of ITU would not be before 1965.

A member of the U.S. delegation told Aviation Week that he did not know of any stations presently using the 90-110 kc. band on a permanent basis.

The ITU representative said, however, that there are between 20 and 30 fixed maritime and aeronautical stations, operating with powers up to 25 kw., using this band at present.

## Pilots' Viewpoint

A representative of the International Federation of Air Line Pilot's Associations told the sub-committee that his organization considered the need for a long range navigation aid to be both immediate and urgent.

In an informal discussion after one of the meetings, the representative, a pilot for BOAC, remarked to some of the delegates that from the pilot's point of view an aid that would do only 50% of what the delegates asked would be useful if installed now because of the broad areas of the earth where there is now no satisfactory aid. The pilot's viewpoint is different, he said, because the pilot "usually considers himself to be the first man at the scene of an accident."

# Tight Money Threatens Jet Stretchout

**Airlines' ability to meet re-equipment loans, make new ones to be major issue in fare investigation.**

By L. L. Doty

**Washington**—Possibility that airlines face a stretchout of their jet transport re-equipment programs will be a pivotal issue in the Civil Aeronautics Board general passenger fare investigation to be resumed next month.

Some carriers already are showing growing concern over the industry's ability to finance the more than $2 billion committed for turbine aircraft unless the continuing trend toward narrowing profit margins is reversed (AW May 13, p. 39). This fact alone is forcing a number of trunklines to take a second look at their jet equipment programs. It was a significant factor in Capital Airlines' decision to halt its turbine equipment program at 60 Viscounts (AW May 13, p. 39).

Observers point out that a few of the long-range loans already confirmed with large insurance companies or bank groups may not be consummated unless the profit squeeze trend is arrested to allow the airlines to meet such specified terms as minimum working capital positions or fixed debt/equity ratios.

The revised thinking, coming in the wake of the Civil Aeronautics Board recent refusal to grant an interim 6% fare increase (AW Aug. 12, p. 38), stems from an industry fear that, although revenues are rising, the increase is not sufficient to offset the rapidly climbing expense level. The carriers claim that only a fare increase can correct a situation which American Airlines terms the "present precarious earnings position of the domestic trunklines."

### CAB Stand

A completely opposite stand has been taken by the Civil Aeronautics Board. In its split decision in the suspended passenger fare increase case, the Board held ". . . There is no evidence as to any inability on the part of the trunkline industry generally . . . to obtain necessary financing for replacement or expansion needs."

Somewhere along the center between these two views stand a number of financial specialists outside the civil aviation industry who are watching the jet equipment program unfold. Although not as vehement in their views on the subject as airline officials, this group warns that domestic carriers are in a relatively weak position to compete effectively for funds in today's highly competitive and tight money market.

Some airline observers feel the carriers might have met with some success in their petition for an emergency fare increase had they mustered the support of these outside experts in order to present an unbiased and objective insight into the problem. In fact, the CAB emphasized in its decision that "no testimony was offered from members of the financial community as to the level of earnings the carriers would require in order to obtain additional financing."

### 'Unsupported Assertions'

CAB member Louis J. Hector stressed this point in a separate concurrence of the Board opinion by charging that evidence offered by the airlines failed to prove the need for a fare increase to produce sufficient earnings to back jet programs.

"In general, the carriers' cases rest on the unsupported assertions of their own executives that an immediate fare increase is necessary for them to complete their equipment program."

The Board itself concluded that the airlines "failed to support their contention that a fare increase is required in order to avoid serious if not irreparable damage to their credit status."

### United Wants 880s

**Chicago—United Air Lines hopes to purchase the Convair 880 turbojet transport for medium-range operations if satisfactory financial arrangements can be completed. The order would round out the first phase of its turbine re-equipment program.**

**Earlier, United had shown strong leanings toward the Lockheed Electra to replace its Convair 340s. However, company officials later decided to confine jet fleet to an all-turbojet operation.**

**United has a total of 30 DC-8s on order at an approximate cost of $5,130,000 each. As of Jan. 1, commitments for the purchase of aircraft, facilities and equipment totaled $253 million under an expansion program scheduled to extend into 1960. Major financial undertaking by the airline involves the sale of up to $120 million of 4% sinking fund debentures to three life insurance companies.**

Vice Chairman Chan Gurney, the lone dissenter in the case, expressed concern that the denial of the "small" fare increase places the airlines in a "critical financial position." He referred to the tightening profit margins which he said "make it impossible for the air industry to compete with other industries for necessary capital to complete its re-equipment program. . . ."

Gurney's views were echoed by one member of a Wall Street investment house who told AVIATION WEEK that public equity financing "will be extremely difficult if not impossible" unless an improved price earning ratio is imminent. He also said the carriers' relatively soft financial condition can be attributed to the low market price of airline stock compared to its book value.

At present, airline common stock has dipped sharply from peak 1957 listings and, in almost every case, has fallen below per share book value.

For example Delta Airlines common stock was quoted on the New York Stock Exchange early last week at $20, a decline from the 1957 high of $26¾, although book value has climbed steadily to $30.27 from $28.47 on Jan. 1. Book value per share of common stock has doubled since 1952.

Under such conditions, new stock issues for equity financing are not likely to meet with the approval of stockholders since such a procedure will give new stockholders a greater per dollar share of an airline's assets than old stockholders possess. This unfavorable market/book value ratio also can have a dissuasive effect on bankers surveying a carrier's ability to take on a heavy financial burden.

Airlines contend that the 6% fare increase would have increased revenues sufficiently to provide a fair rate of return on stockholders' equity and permit a sufficient yield to attract investors. An improved price earnings ratio, they say, would result from a fare increase and bring the market/book value ratio of stock into normal alignment to permit a stronger base for equity financing.

CAB has estimated that the 6% fare increase would add approximately $67 million a year to domestic trunkline airline revenues. American Airlines has estimated that the industry is currently short $300 million in the capital funds needed to support jet equipment purchased thus far.

Although a number of airlines have completed arrangements for future long-term loans to cover their re-equip-

# New Engine Shutdown Deepens Britannia Woes

New York—Forced shutdown of two of its Proteus 755 engines in flight over Florida last week did little to ease the problems besetting the Bristol Britannia. Trouble was mechanical and the manufacturer does not believe it was connected with icing difficulties encountered in the earlier Proteus 705 engines.

The British Overseas Airways Corp. Britannia 312 landed at Miami International Airport on two engines after running into trouble at about 22,000 ft. in clouds and turbulence. Plane, which carried about 30 BOAC and Bristol technicians, had arrived at Idlewild after a trouble-free transatlantic flight. BOAC was taking it to the Caribbean as part of a proving program during which special atmospheric conditions connected with previous flameouts were to be sought.

Incident, which occurred about an hour out of Miami, was definitely not a case of flameouts, Bristol said. Number 2 and 4 engines were shut down when high tailpipe temperatures developed. No damage to guide vanes was found, indicating icing was not a factor.

Plane was still at Miami last week and its engines were being removed for shipment back to Bristol for study. Manufacturer believes trouble is one it has in hand with modifications already under way. Incident has not affected BOAC's plans to begin service with the long-range Britannia next year, a spokesman said. Plane's other buyers are waiting for Bristol's investigation before changing any plans.

Bristol has agreed to postpone delivery of Northeast Airlines' Britannias until next fall, but the deal is subject to important ifs. The turboprops were delayed too long for the 1957-58 peak season, and the airline doesn't want them delivered between seasons (AW Sept. 30, p. 37).

It "may be some time" before the contract can be renegotiated with the fall delivery date, a Bristol spokesman said. Bristol as well as Northeast is losing from the postponement, the spokesman said, and both realized from the beginning that early delivery was a big gamble and both stood to lose if Civil Aeronautics Administration required too much modification.

Plane will not be certified by CAA until a permanent fix is found for the icing problem.

Northeast wants its Britannias at their original price, about $200,000 under that for today's customers, and some concessions by Bristol in paying import duty costs, as had been previously agreed.

Blame for the failure to meet Northeast's delivery schedule is laid by Bristol on CAA requirements. Bristol said it had to meet 114 modifications, including alterations in landing gear, fire extinguishing system, emergency exits and navigation lights.

Regarding icing problems with BOAC's Britannia 102s, Bristol Managing Director Peter Masefield said they were never hazardous. Only 13 flameouts occurred in 3,800 Britannia 102 flights, he said. Only one engine at a time was involved, no engine was out more than 10 seconds, and there was never an altitude loss.

Three possibilities for a permanent fix of the Proteus being tested, Masefield said, are application of heat to the rear wall of the duct, use of "rabbit warren" multiple ducts to distribute heat, and installation of flush intakes.

Whatever the permanent modification is, Masefield said, it will be handled retroactively and will not involve any additional delivery delays.

The Britannia has embarrassed its manufacturer in the timing of its engine incidents. When the second prototype developed fire in No. 3 engine and was crash landed in a mud flat on the Severn River in early 1954, two executives of KLM Royal Dutch Airlines were aboard for a demonstration. Early this year a Britannia developed engine trouble en route from Vancouver, B. C., to Hawaii and turned back, carrying Canadian Pacific Airlines President G. W. G. McConachie among its passengers.

ment programs, investment brokers point out that such contracts can collapse even before the funds are made available. Most individual financial programs, which include long-term loans, are coupled with depreciation throw-offs, proceeds from the sale of old equipment and retained earnings. Since these airlines have established their ability to repay the loans according to retained earnings, bankers have set certain ratios between the projected debt and corporate equity as one of the terms for most long-range borrowing. In addition, working capital must be held at a minimum level as a requirement.

As one broker explained, when earnings began to dwindle with signs that the pinch is not temporary, bankers will revise their financial projections with the possible result that the airline in question no longer qualifies for the loan under its original terms or conditions.

According to W. B. Harding, a partner of Smith, Barney and Co., New York brokerage firm, airlines will remain in an "extremely unfavorable" position to undertake any equity financing so long as earnings are down and security prices are "sharply off." Harding says the airlines are entitled to a fare increase if only "to give security listings a shot in the arm."

### Need for Increase

On this point, CAB said in its decision on the application for a 6% fare increase that the need for such an increase depends on whether earnings have provided and will provide a fair return to the airlines. It added that a vital factor in this decision rested on finding whether recent and forecast depressed earnings were due to short term factors.

The Board said evidence in the case showed that the airlines "have had substantial earnings in the past" and that this condition will continue in the future. It said that an 8% return on investment had been selected as "the yardstick reflecting a just and reasonable level of earnings" and charged the airlines with submitting a dollar amount of earnings without suggesting any particular rate of return.

Average rate of return of the trunkline carriers for the period during which they have been subject to the Civil Aeronautics Act of 1938 has exceeded 8%, the Board said. It added that during the past seven years, all carriers except Northwest Airlines have realized earnings that "are in excess of the 8% standard deemed fair and reasonable, ranging from 9.18% for TWA to 12.86% for Delta."

During the case, the airlines protested against the inclusion of capital gains in the determination of fair earnings on the grounds that such revenues were infrequent, non-recurring and a type of income that is ploughed back into new equipment.

The Board countered that "if the carriers' capital gains are infrequent and non-recurring as claimed . . . little, if any, distortion of the average earnings would result from the inclusion of capital gains." It concluded that ". . . even after elimination of retirement gains, the earnings reported by the airlines have been substantial."

CAB held that the present decline in reported earnings is attributable to short term factors. It dismissed the airlines' position that depressed earnings are due to increased competition and

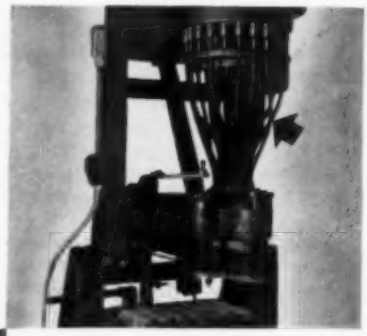
S. S. White

# Flexible Shafts Step Up Design Efficiency

The manufacturer of this multiple spindle drill press finds that S.S. WHITE FLEXIBLE SHAFTS allow a wide range of positions for different drilling jobs.

This is only one example of the versatility . . . efficiency . . . and freedom S.S. WHITE FLEXIBLE SHAFTS are bringing to hundreds of industrial designs. The restrictions imposed by rigid shafting are eliminated. With flexible shafts you position power sources . . . driven members . . . controlled parts to better advantage. By simplifying methods of connection and adapting, costs can be reduced. Assembly is cheaper . . . alignment problems are eliminated . . . and product efficiency is often greatly improved!

Consider your own product. Chances are, S.S. WHITE FLEXIBLE SHAFTS are the simple, economical answer to your power drive and control problems. S.S. WHITE FLEXIBLE SHAFTS are noted for quality, performance and dependability. For more information and expert assistance in selecting and applying an S.S. WHITE flexible shaft to your product, just write to



S. S. White

FIRST NAME IN FLEXIBLE SHAFTS

*USEFUL DATA on how to select and apply flexible shafts! Write for Bulletin 5601.*

S. S. White Industrial Division, Dept. V, 10 East 40th St., New York 16, N. Y. Western Office: 1839 West Pico Blvd., Los Angeles 6, Calif.

rising costs which no longer can be absorbed through new economies and efficiencies as "not novel" and added:

"To the extent that the record shows rising costs of any kind, it also shows that the traditional factors that have enabled the industry to absorb higher costs are still operative and are likely to offset recent cost increases."

The Board classified recent unit cost increases as "non-recurring" and attributed them to the cost of new equipment, implementation of new routes and construction of new maintenance facilities. It admitted there will be a "tendency" toward higher unit costs due to low load factors during early experimentation of schedules on new routes but prophesized a return to high level load factors once "experience with the needs of the market is obtained."

On the financing of jet equipment, the Board said both Braniff and United have no immediate financing problems "since they have completed their present financing requirements." However, United announced last week that it had deferred public announcement of its decision to purchase medium-range turbine equipment pending the completion of financial arrangements.

### Braniff Reply

Braniff said it will be unable to draw on the available financing unless it maintains sufficient working capital and meets other financial conditions. The Board retorted that, "beyond the bare allegations," Braniff failed to offer any evidence that shows it will be unable to meet the conditions of the $40 million, 4¼% equipment mortgage sinking fund bonds arranged through seven life insurance companies without an increase in present fare levels.

With respect to United's program, the Board said that, "since the carrier has presented no evidence as to what such equipment plans are, it is obvious we have no basis upon which to determine that it needs increased fares for this purpose."

Delta's claim that it must raise half of the $35 million needed for the purchase of 10 Convair 880 jet transports through equity and half through debt drew this comment from the Board—"The carrier's evidence in support of an emergency fare increase is both sparse and vague." It also emphasized that Eastern failed to prove it could not complete its $425 million re-equipment program without a fare increase.

In discussing Northwest's plea for a fare increase, the Board said the Northwest witness "merely expressed the hope that some of the necessary funds would come from a fare increase, without indicating the particular need for a 6% fare increase as opposed to a one, two or any other percentage of increase." It concluded:

"No carrier has shown that it cannot finance at existing fare levels, or what difference in financing ability a 6% fare increase would make."

Many strong advocates of a fare increase are willing to agree with the Board's conclusions that the case presented by the seven airlines in the 6% case was not as strong as it might have been.

### General Investigation

However, there are few persons involved in the case who feel that the case for a fare adjustment, which will be covered in greater detail in the general passenger fare investigation, will be prejudiced in any way by the Board's decision. The investigation will be resumed next month after a four-month suspension called to handle the airlines' emergency request for the 6% increase.

Board member Harmar Denny is especially clear on this point. In his concurrence in denying the 6% increase, he emphasized that his decision was based entirely on the issue of whether or not "an emergency exists and interim relief is required by the carriers pending disposition of the general passenger fare investigation." He added:

"With this in mind, I wish to make it clear that nothing in the present opinion should imply or constitute a determination on my part of any of the issues in the general passenger fare investigation."

Louis Hector admitted that business projections cannot always be made with accuracy but stressed that the presentation of traffic projections and financing and equipment plans "would not be an undue burden on the carriers." He said the "Board must assume that the managements of these carriers would not have embarked upon programs of such vast magnitude without the projections and plans to support them."

The split decision of the Board in the suspended passenger fare increase case, coupled with the amendments to concurrences by Denny and Hector, indicate a more sympathetic leaning toward the jet equipment program problems that is implied in the wording of the decision. It is possible that the threatened delay in the jet program may accelerate this leaning toward direct action in favor of some type of fare adjustment.

Already, Capital Airlines has canceled its order for de Havilland Comet jet transports as well as plans to augment its Viscount fleet with 15 additional aircraft because of the high interest costs involved in the financing. American Airlines recently dropped plans to purchase the Douglas DC-7D turboprop cargo transport because of the "difficult airline financing picture (AW Sept. 16, p. 42)."

Northeast will be forced to negotiate new bank loans as the result of the delivery delay of its five Bristol Britannia turboprop transports (AW Sept. 30, p. 37).

Northwest Airlines has yet to arrange satisfactory financial arrangments to back a jet equipment program although its president, Donald W. Nyrop, feels that the strengthening of present markets with piston-engine equipment during the next three years will place his company in a better position to make the transition to turbine aircraft.

The real problem behind the jet equipment program has been summarized by American Airlines in a report pointing out that the $2 billion obligation of the industry for jet equipment is double the aggregate net worth of the airlines as of last December and 27 times their net profit for 1955, the highest in the history of the industry.

American also points out that retained earnings of the domestic carriers from net operating income were approximately $30 million during 1956. Assuming that profits remain at comparable levels during the 1957-60 period, American says, retained earnings would amount to about $120 million, 20% of the $600 million for which no arrangements have yet been made.

### Declining Load Factors

Some airlines question the industry's ability to fill projected seat capacity and fear load factors may follow the gradual decline that has been experienced during the past six months. However, Donald W. Douglas, president-board chairman of Douglas Aircraft Co., points out that studies by his company show the U.S. demand for scheduled seat miles will exceed the supply in 1965 by 14.5 billion to 24.5 billion seat-miles.

Douglas adds that his company feels the present 64% load factor is too high for a sustained average because it restricts scheduling flexibility. He estimates that turbine aircraft will have a 50% break even load factor by 1965.

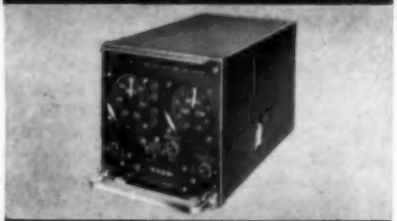
Some observers feel the declining load factors may call for a readjustment of the overall fare structure. They say airlines operating over high-density routes will benefit from a fare increase to a far greater degree than carriers servicing routes which generate a small amount of traffic.

However, some airline officials feel that, although an adjustment of the fare structure may be in order, as a means of eliminating fare inequities on a number of route segments, such action will require several years of intensive work. Such a program, they say, should supplement an overall fare adjustment on a long-term basis.

# Marconi's hand in radio and radar flying aids

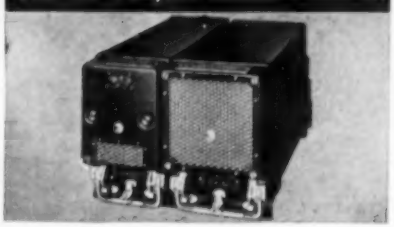
The world of aviation relies upon Marconi's for radio and radar flying aids to match the range and performance of the most modern aircraft and to serve the traffic of the busiest modern airports. But more than that is expected of Marconi's. Working with Governments, Air Forces, Air Lines and Aircraft Constructors, Marconi's are devising electronic equipment which is helping to shape the future of aviation. A great tradition of pioneering and enterprise is being most capably upheld.

**FOR LONG RANGE:**
**DOPPLER NAVIGATORS**



**FOR MEDIUM RANGE: A.D.F**

**FOR SHORT RANGE:**
**VHF for VOR/ILS Communication**

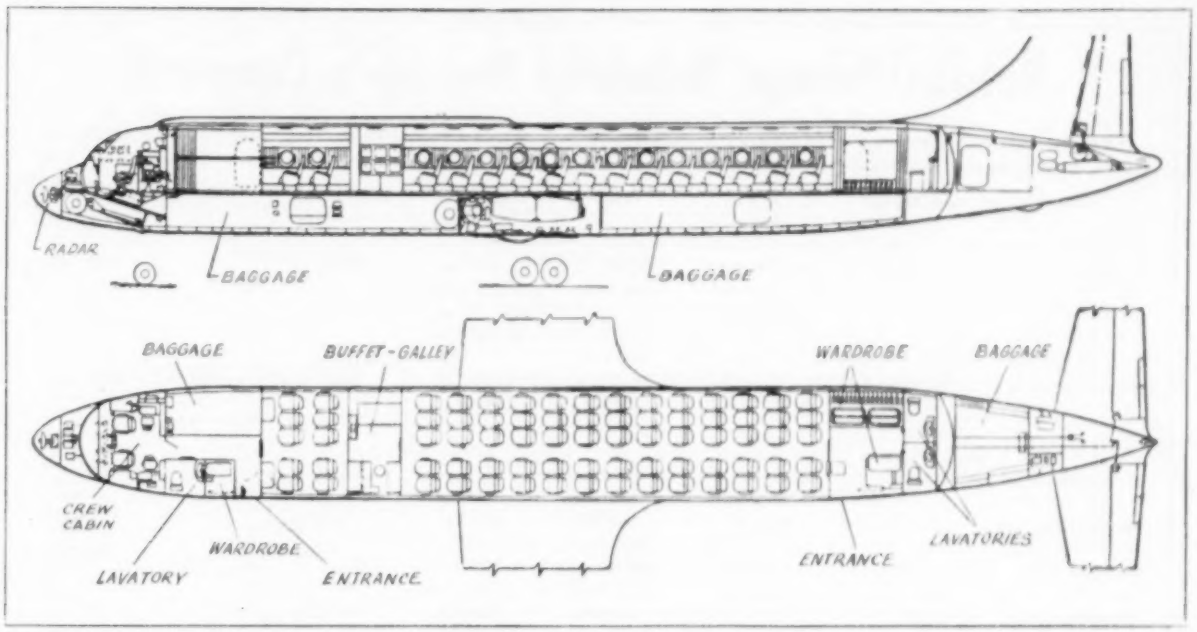


# MARCONI

## Airport and Aircraft Radio and Radar Systems

E. J. HIRD, AERONAUTICAL REPRESENTATIVE, MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, 1346, CONNECTICUT AVENUE, N.W., WASHINGTON 6, D.C.

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX, ENGLAND




**DIAGRAMS** show passenger and crew accommodations on the Ilyushin-18 Moscow.

# Titanium Used on Aeroflot's Ilyushin-18

Moscow—One of first users of titanium among Russian aircraft is the new Ilyushin-18 turboprop transport, the Moscow. Aeroflot, the state-owned airline, reports that the Moscow has titanium structure around the hot portions of the engines and their exhaust pipes.

Russian report also substantiates and enlarges earlier AVIATION WEEK reports of the aircraft's basic characteristics. (AW July 22; p. 27).

Moscow, by new Aeroflot claim, has the lowest ton-mile operating cost of any foreign or domestic transport. This operating cost plus the utilization provided by the 400 mph. cruise speed is said to give the 75-100 passenger Moscow the largest profit-making potential of all transports.

### Engines Described

Four NK-4 turboprop engines, each developing 4,000 eshp., power the Moscow. The engines are credited to N. D. Kuznetzov, a pioneer Russian propeller turbine designer. Powerplants are mounted slightly above the wing in small nacelles. The main landing gear is housed in the inboard nacelles which are larger than the outboard.

Four bladed, reversible, full-feathering, constant-speed propellers are used on the Moscow. Feathering is accomplished automatically if an engine stops in flight while operating at more than 90% power. Otherwise feathering is manual.

The reversible propellers are used to keep the landing run down to 1,640-1,968 ft., depending on gross weight of the particular aircraft.

Aeroflot indicates that the mechanical design of the propellers is an advance over all existing types. Radial play cannot develop on these props because of new ball bearing fastenings on the butt ends. Wind cannot turn propellers when the aircraft is stopped on the ground because of a built-in lock.

The Moscow has sufficient power to take off fully loaded if one engine fails during the takeoff run, and can also maintain level flight on two engines. The takeoff distance at maximum gross weight under normal conditions is 2,296-2,460 ft.

This is impressive when compared with the DC-7C, a transport of similar weight and dimensions, only 1,000 less horsepower. It needs approximately 6,000 ft. to take off at maximum gross.

Aeroflot reports that the new Ilyushin transport can be operated into all of the airports on its domestic routes. Some of these fields are known to be unpaved and Aeroflot attributes the Moscow's rough field ability to low takeoff and landing speeds, and to a 29.5 ft. spread between the main wheels to make cross wind landings easier. Each unit of the main landing gear has four bogied wheels and can support the aircraft if one wheel on each side is punctured.

Construction and layout of the Moscow is conventional; its external appearance is somewhat similar to the latest Douglas piston engine transports. Fuselage is of monocoque construction and is basically broken down into two sections. The forward section is by far the largest (91 ft. 10 in. long), and contains all of the pressurized area. Design of pressure cabin and its effect on the rest of the aircraft have received special attention, according to Aeroflot. The most vital places have received "double strength."

The wing is straight with a trapezoidal shape and has a 122.7 ft. span. It consists of a center panel and two detachable tip sections. The three spar center panel is about 72 ft. long. The fuselage, engine nacelles, main landing gear and flaps are attached to it.

The fuel tanks are also located in the wings. The system is broken down into two symmetrical groups, one each for the right and left engine groups.

### Control Surfaces

The empennage is all metal with surfaces of unswept trapezoidal shape.

Control surfaces on the aircraft are not powered in keeping with a general Aeroflot belief that the greater reliability of stiff rod mechanical control linkages should be taken advantage of when possible. The surfaces are mass balanced, with the ailerons using aerodynamic compensation as well. Spring loaded trim tabs are provided.

Control during taxiing is accomplished with a steerable nosewheel which can turn 45 deg. to either side. It is operated by a star knob located on the column of the pilot's control wheel. When the aircraft is stopped the

# Russian, Foreign Turboprop Transports Compared

**General performance comparison of some major turboprop projects is shown here. The familiar Vickers Viscount series now in service in North America is included to give a reference for judging the new aircraft. All figures are the manufacturers'.**

| Aircraft | Max. Takeoff Weight | Cruise Vel. & Altitude | Power | Range & Payload | Maximum Payload | Passengers | Status |
|---|---|---|---|---|---|---|---|
| Antonov Ukraina | 112,435 lb. | 373-404 mph. @ 26,250 ft. to 32,810 ft. | (4) NK-4 4,000 eshp. | 1,242 mi. @ 26,455 lb. 2,174 mi. @ 18,078 lb. | 28,660 lb. | 84 | Flight Test |
| Ilyushin Moscow | 127,867 lb. | 404 mph. @ 26,240 ft. | (4) NK-4 4,000 eshp. | 1,242 mi. @ 30,856 lb. 3,105 mi. with smaller load | 30,856 lb. | 75-100 | Flight Test |
| Vickers Viscount | 60,000 lb. | 334 mph. @ 20,000 ft. | (4) Rolls-Royce 1,600 eshp. | | 12,250 lb. | 40-59 | Service |
| Vickers Vanguard | 135,000 lb. | 400 mph. | (4) RR 4,020 eshp. | 3,150 mi. @ 21,000 lb. | 21,000 lb. | 76-115 | Production |
| Lockheed Electra | 113,000 lb. | 405 mph. @ 25,000 ft. | (4) Allison 3,750 eshp. | 2,770 mi. @ 18,000 lb. | 21,000 lb. | 66-85 | Beginning Construction |
| Bristol Britannia 300 Series | 155,000 lb. | 350-385 mph. | (4) Bristol 4,120 eshp. | 3,450 mi. @ 30,000 lb. | 30,000 lb. | 99 | Service |

rudders and ailerons can be locked from the cockpit.

Moscow uses hydraulic and electrical power to operate its equipment. The hydraulic system uses 3,000 psi. pressure. It retracts and lowers the landing gear, brakes the wheels, turns the front wheel when taxiing, and runs the windshield wiper. Emergency braking of the landing gear wheels is done by a gas system. Reliability of the landing gear lowering process is insured because of the forward-retracting nose wheel. All of the gear will come down from the effect of its own weight and the air stream.

### Electrical Power

Moscow uses a.c. and d.c. power. Eight engine-driven generators, mounted two on each engine, furnish d.c. power. They double as starters. The alternating current is 400 cycle and is provided by single-phase, 115-volt generators. The a.c. is used to heat the canopy glass and propeller blades. The storage battery capacity of the Moscow is described as large.

Electronic equipment includes navigational radio instruments, radar, glide path system receivers and many others, according to Aeroflot.

De-icing system is described as electrothermal. Its protection extends to the wing, empennage, the propeller and propeller hub. The engine air intakes are de-iced by hot air. If any surface becomes overheated the de-icing systems are cut off automatically. Light signals permit the crew to monitor the de-icing systems continuously.

Passenger cabins are described as roomy. Height of the ceiling along the center aisle is about 6.6 ft. Width of the center aisle is about 1.6 ft.

The fuselage windows are circular—about 16 in. in diameter. There are 30 of these windows in the cabin, providing good lighting. Small silk curtains are at each window. Walls below the windows are trimmed with laminated plastic which is an imitation of expensive types of wood. The sides and ceilings are covered with a fireproof and easily-washed plastic material called "pavinol." The covering is done in the form of separate panels. This simplifies repair work on the trim and gives the cabins a smart appearance.

Continuous baggage racks run along the sides of the passenger cabin. They are also covered with "pavinol." Each seat is equipped with a reading lamp, a ventilating nozzle to blow cool air and a button to summon the hostess.

Recesses for attaching children's cradles are provided on the forward walls of the passenger cabins.

### Air Conditioning

The passenger cabins are also equipped with dome lights and heated by air conditioning. The conditioned air goes through vents at the base of the wall. Air pressure in the cabin is maintained at a steady level. Up to 16,400 ft. the pressure in the cabin is the same as at ground level, and at 32,800 ft. it corresponds to a pressure altitude of 7,870 ft.

To cool the cabin in the summer, a turbocooler is installed in the system which feeds the conditioned air. This turbocooler utilizes compressed air from the engine. It is turned on automatically and its capacity rises in proportion to the increase in outside temperature.

Crew compartment is forward and accommodates a crew of five. The navigator's seat is behind the captain's while the radio operator is behind the copilot. A removable seat for the flight engineer is installed in the aisle between the pilots.

The cockpit canopy fits into the contours of the fuselage nose and consists of flat, single silicate glass panes, according to Aeroflot.

### Insulating Vestibule

Just aft of the flight crew's compartment is a section 9.7 ft long which contains a 247 cu. ft. baggage hold, a lavatory and a wardrobe for the crew's clothes. This section also serves as an insulating vestibule which protects the passenger cabin from being chilled during ground stops.

Buffet section is located to the rear of the forward passenger cabin and is in the area of the turning propellers. It is equipped to serve hot and cold beverages and meals. It contains a refrigerator, boiler, electric range, cupboards and other housekeeping facilities.

Main passenger cabin is behind the buffet. It has 13 rows with five seats in each row. The seats are fastened to longitudinal rails with socket clamps. Space between seats may be decreased when it is necessary to increase capacity.

Seats were developed by the Ilyushin Design Bureau. Bottom, back, and sides of the seats are filled with an elastic and light foam plastic—"porolon"—and are covered with plush. Each

seat weighs 17.6 lb. On the back of each of these reclining seats is a pocket containing literature and a small table.

A housekeeping section is located behind the main passenger cabin. It consists of a wardrobe and two lavatories. The main passenger door is here.

The tail section of the fuselage behind this housekeeping area is unpressurized. It houses the upper rear 247 cu. ft. baggage compartment.

Two large baggage compartments located under the passenger cabin have a total volume of 988 cu. ft.

## SHORTLINES

► **Trans World Airlines** will provide sleeper seat accommodations on all its transcontinental Lockheed 1649 Constellation flights beginning Oct. 14. Each 1649 will have 31 sleeper seats in the first-class compartment at no extra charge. The seats can recline 55 degrees as opposed to 38 degrees on conventional seats. On Oct. 27, TWA plans to increase its domestic first-class capacity by 40% over that of the same period of last year and by 109% on its international routes. The airline's winter schedule begins Oct. 27.

► **Ozark Air Lines** plans to begin nonstop service between St. Louis and Moline, Ill.-Davenport, Ia., on Oct. 27. A recent Civil Aeronautics Board decision authorized the nonstop flights. Ozark estimates the new schedule will reduce the flying time from St. Louis to Moline-Davenport to 70 minutes—a saving of about 45 minutes over present schedules which include two intermediate stops.

► **International Civil Aviation Organization** reports that six Latin nations will inaugurate the Central American Flight Information Region on Oct. 21. The six nations are Costa Rica, Nicaragua, Honduras, El Salvador, Guatemala and British Honduras. Tegucigalpa, Honduras, will be the overall center of the new region—a unified block of airspace from which all obstacles normally imposed on civil aviation operations by the existence of national boundaries have been removed. When the Central American region begins operation, all information required by pilots flying through the region will be coordinated at the center in Tegucigalpa. The center also will plot position reports and keep track of all aircraft flying in the region.

► **Continental Air Lines** will fly a special flight of 50 West Coast business, political and entertainment leaders to Dallas on Oct. 23 for the dedication of new terminal facilities at Love Field.

## AIRLINE OBSERVER

► Interline business this year will exceed the total of all on-line traffic handled by the domestic carriers in 1946. Although the marked rise is due in large degree to increased competition on major route segments, a large part of today's interline traffic is generated by the growing local service airlines. As a result, trunkline carriers are cooperating closely with the smaller lines in such ventures as joint advertising and sales campaigns and personnel training programs.

► **Jugoslovenski Aero Transport (JAT) has purchased two Douglas DC-6Bs for delivery in late 1958. Negotiations for the sale and arrangements for export licenses were handled under State Department authorization. Contract involves approximately $1.5 million for each aircraft not including spares.**

► Northeast Airlines and Eastern Air Lines last week were handling overflow Florida traffic with normal schedules despite the grounding of National Airline flights because of a strike by the Air Line Agents Assn. (AW Sept. 30, p. 25). Northeast has operated two extra sections on one occasion but beyond that there has been no indicated need for additional service to accommodate Florida traffic which is normally low this time of the year. To increase its service, Eastern would be required to pull aircraft from its pilot training program, a step it is reluctant to take in view of the additional equipment it is scheduled to receive during the balance of the year.

► **Northwest Airlines contends that 92% of its entire domestic profit is derived from its Chicago-Minneapolis route segment. The airline told the Civil Aeronautics Board that additional competition between Chicago, Milwaukee and the Twin Cities would seriously effect the economics of the airline. In the Great Lakes-Southeast Service Case, the airline seeks a Chicago-Florida route to offset the seasonal slump during the first quarter of the year on its northern transcontinental route.**

► Southwest Airmotive is the first overhaul firm in the U.S. to receive a Civil Aeronautics Administration certificate for commercial overhaul of turbojet engines. Southwest's license is based on its military contract overhaul work on the Allison J33 engine (AW May 13, p. 71).

► **Civil Aeronautics Administration has leased from the Canadian Department of Transport a $5.5 million electronics computer for 15 years at $1 per year. The computer was originally designed as a military tactical trainer, will be converted for use as a dynamic operational air traffic control simulator. Following conversion, it will be installed at the CAA Technical Development Center in Indianapolis.**

► Conference of Local Airlines will retain its identity but all its administrative functions will be absorbed by the Air Transport Assn. The seven local service airline members of the organization will use the conference to handle any problems pertinent to local service carriers through the Washington law firm of Kirkland, Fleming, Green, Martin and Ellis. John Floberg, who resigned as CLA chairman when he was named to the Atomic Energy Commission, is a member of the law firm. Six other carriers earlier this year formed the Association of Local and Territorial Airlines which is headed by Joseph Adams as executive director.

► **Instrument landing separation at Honolulu International Airport has been changed from a four minute time spacing between aircraft to a distance separation of three miles. CAA expects the new procedure will accelerate acceptance rate of the airport from one instrument landing every four minutes to one landing a minute.**

► Qantas Empire Airways plans to start its new around-the-world route via the U.S. in December with Lockheed 1049G Constellations. The schedules, which include two weekly flights, will be the first around-the-world service offered by a single carrier. The routing was made possible by the bilateral agreement between the U.S. and Australia signed last summer.

# NOW! MORE LUXURY SERVICE EUROPE

# TWA JETSTREAM*

EQUIPPED WITH RADAR AND SYNCHROPHASED (ANTI-VIBRATION) PROPELLERS

## NOW! NON-STOP NEW YORK TO ROME

Fly the great, new TWA Jetstream to Rome! Leave New York before dinner, arrive next day at brunch-time! Enjoy fast, luxurious Jetstream flight. This giant Lockheed Starliner offers the *quietest* trip ever! Choose de luxe First Class Ambassador service. Or go Golden Banner Tourist and *save!*

## NOW! ON THE SHORT POLAR ROUTE

### CALIFORNIA—EUROPE

Fly the Jetstream direct from Los Angeles and San Francisco to the *heart* of Europe . . . London, Paris, Rome. No change of plane. Fly today . . . arrive tomorrow. How ever you go . . . across the top of the world or non-stop from New York . . . go TWA Jetstream. For reservations and information, call your travel agent or nearest TWA office.

***Across the Top of the World***

The Jetstream flies the Great Circle Polar Route. It's about 343 miles shorter to Europe from California!

***FLY THE FINEST***

**FLY TWA**

**TRANS WORLD AIRLINES**

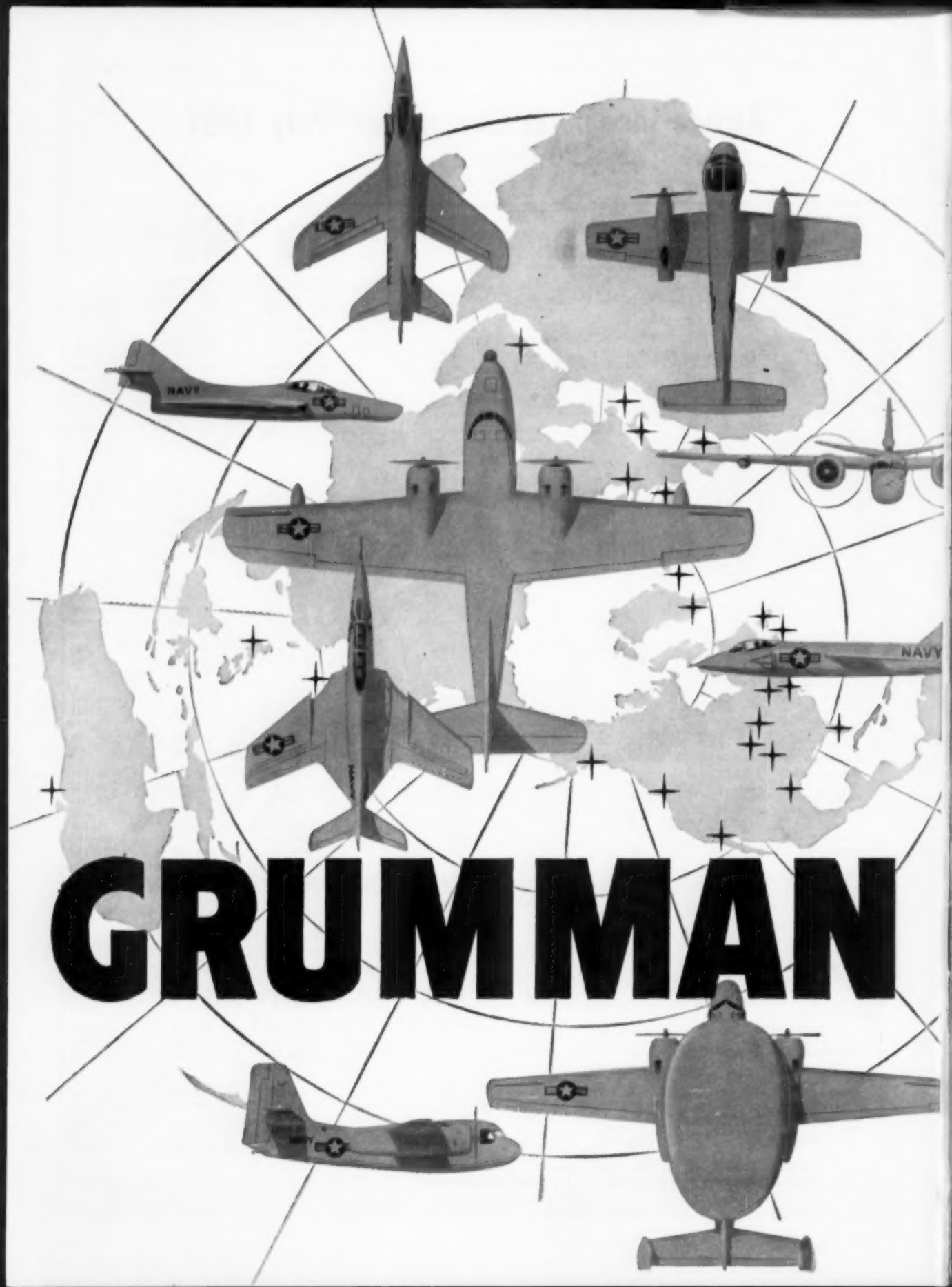
**Jetstream is a service mark owned exclusively by TWA*

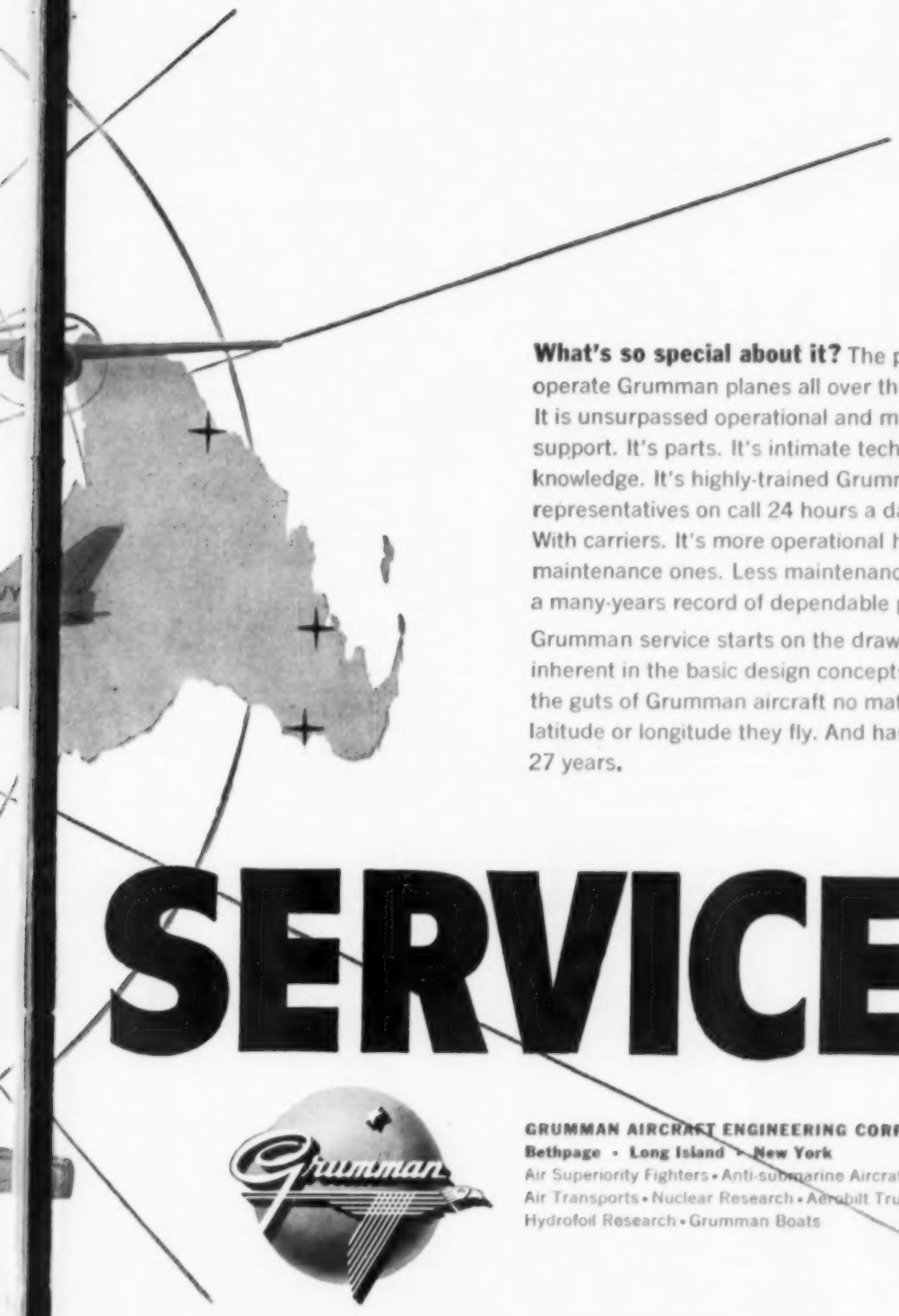
# Airline Income & Expenses—July 1957

(In Dollars)

| | Passenger Revenue | Mail Revenue | Express Revenue | Freight Revenue | Total Operating Revenue | Total Operating Expenses | Total Operating Income (before taxes) |
|---|---|---|---|---|---|---|---|
| **DOMESTIC TRUNK** | | | | | | | |
| American | 23,717,768 | 528,131 | 190,250 | 1,508,159 | 26,328,221 | 24,773,601 | 1,554,620 |
| Braniff | 4,293,982 | 104,799 | 30,322 | 141,753 | 4,652,518 | 4,444,013 | 142,392 |
| Capital | 7,587,697 | 159,884 | 61,264 | 146,366 | 8,089,068 | 8,302,775 | −213,707 |
| Continental | 1,973,499 | 44,807 | 15,675 | 56,097 | 2,142,507 | 2,086,670 | 55,837 |
| Delta | 5,602,677 | 126,955 | 48,406 | 210,389 | 6,132,630 | 5,856,682 | 275,948 |
| Eastern | 18,075,471 | 220,754 | 670,984† | ..... | 19,088,336 | 18,775,336 | 313,000 |
| National‡ | 3,931,978 | 84,857 | 16,032 | 129,317 | 4,307,328 | 4,046,878 | 260,450 |
| Northeast | 1,537,840 | 15,294 | 9,112 | 29,430 | 1,612,401 | 1,743,747 | −131,346 |
| Northwest | 4,691,692 | 135,742 | 344,466† | ..... | 5,200,642 | 4,674,675 | 525,967 |
| Trans World | 17,295,992 | 315,784 | 874,701† | ..... | 18,689,361 | 17,756,474 | 932,887 |
| United | 22,816,657 | 784,810 | 155,274 | 1,182,629 | 25,216,192 | 22,666,076 | 2,556,116 |
| Western | 3,644,513 | 84,243 | 23,297 | 76,456 | 3,879,776 | 3,190,277 | 689,498 |
| **INTERNATIONAL** | | | | | | | |
| American | 495,495 | 5,759 | 225 | 66,042 | 596,887 | 490,543 | 106,344 |
| Braniff | 709,444 | 29,360 | ..... | 35,203 | 825,468 | 711,672 | 103,318 |
| Caribbean-Atlantic | 175,575 | 1,836 | 5,399† | 14,096 | 190,352 | 142,415 | 47,936 |
| Delta | 502,754 | 4,444 | ..... | ..... | 545,906 | 464,814 | 81,092 |
| Eastern | 2,108,203 | 31,117 | 59,705† | ..... | 2,048,701 | 1,502,323 | 546,378 |
| National‡ | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Northwest | 1,895,455 | 446,182 | 291,194† | ..... | 2,721,334 | 2,128,393 | 592,940 |
| Pan American | | | | | | | |
| Alaska | 516,000 | 20,000 | ..... | 61,000 | 607,000 | 717,000 | −110,000 |
| Atlantic | 11,447,000 | 526,000 | ..... | 809,000 | 13,519,000 | 11,210,000 | 2,309,000 |
| Latin American | 7,234,000 | 188,000 | ..... | 1,042,000 | 9,127,000 | 8,441,000 | 686,000 |
| Pacific | 5,570,000 | 418,000 | ..... | 535,000 | 7,286,000 | 6,419,000 | 867,000 |
| Panagra | 1,265,000 | 40,000 | ..... | 141,000 | 1,709,000 | 1,581,000 | 128,000 |
| Trans World | 6,219,967 | 415,423 | 407,550† | ..... | 7,366,811 | 6,070,620 | 1,374,636 |
| United | 1,445,516 | 3,937 | ..... | 18,939 | 1,468,558 | 1,133,355 | 335,203 |
| **LOCAL SERVICE** | | | | | | | |
| Allegheny | 522,231 | 9,067 | 6,851 | 19,027 | 737,669 | 763,810 | −26,141 |
| Bonanza | 169,680 | 2,185 | 1,165 | 4,107 | 298,580 | 314,444 | −15,864 |
| Central | 134,793 | 3,899 | 1,055 | 5,068 | 345,144 | 355,915 | −10,772 |
| Frontier | 324,045 | 192,830 | 2,454 | 24,109 | 599,672 | 539,805 | 20,588 |
| Lake Central | 137,132 | 4,330 | 7,277† | ..... | 276,955 | 296,045 | −19,090 |
| Mohawk* | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| North Central | 729,862 | 179,362 | 10,244 | ..... | 950,488 | 973,779 | −23,291 |
| Ozark | 372,390 | 236,659 | 4,029 | 12,811 | 631,284 | 655,145 | −23,861 |
| Piedmont | 493,775 | 8,366 | 3,187 | 9,228 | 756,615 | 689,594 | 67,021 |
| Southern | 192,563 | 7,652 | 3,608 | ..... | 379,231 | 376,607 | 2,624 |
| Southwest | 334,560 | 9,269 | 2,804 | 4,218 | 526,153 | 494,304 | 31,849 |
| Trans-Texas | 297,960 | 9,289 | 2,908 | 13,255 | 583,556 | 552,873 | 30,683 |
| West Coast | 234,357 | 4,197 | 1,516 | 4,224 | 381,823 | 379,603 | 2,220 |
| **HAWAIIAN** | | | | | | | |
| Hawaiian | 525,951 | 2,751 | ..... | 64,435 | 617,419 | 543,820 | 73,599 |
| Trans-Pacific | 274,135 | 965 | 10,389† | ..... | 296,238 | 256,016 | −982 |
| **CARGO LINES** | | | | | | | |
| Aerovias Sud Americana | ..... | ..... | ..... | ..... | 153,993 | 154,949 | −4,306 |
| Flying Tiger* | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Riddle* | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Seaboard & Western* | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Slick | ..... | ..... | ..... | ..... | 1,981,122 | 2,802,076 | −188,954 |
| **HELICOPTER** | | | | | | | |
| Chicago Helicopter | 28,140 | 83,580 | ..... | ..... | 111,733 | 134,792 | −23,059 |
| Los Angeles Airways | 18,467 | 9,740 | 6,114 | ..... | 116,011 | 95,007 | 20,873 |
| New York Airways | 64,935 | 4,839 | 1,644 | 3,348 | 218,831 | 212,793 | 6,037 |
| **ALASKAN** | | | | | | | |
| Alaska Airlines | 164,717 | 47,035 | 1,025 | 75,294 | 480,808 | 502,759 | −21,950 |
| Alaska Coastal | 82,306 | 8,078 | ..... | 11,130 | 155,567 | 119,877 | 35,690 |
| Cordova | 13,864 | 24,686 | ..... | 9,083 | 206,202 | ..... | 44,062 |
| Ellis | 70,090 | 4,870 | ..... | 6,643 | 116,069 | 90,351 | 25,718 |
| Pacific Northern | 760,825 | 62,722 | 103,734† | ..... | 1,012,008 | 875,799 | 136,209 |

*Not Available; †Property Figure; ‡System Figure; —Minus.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.


NAVY
NAVY
GRUMMAN



**What's so special about it?** The people who operate Grumman planes all over the world know. It is unsurpassed operational and maintenance support. It's parts. It's intimate technical knowledge. It's highly-trained Grumman representatives on call 24 hours a day. On land. With carriers. It's more operational hours. Fewer maintenance ones. Less maintenance cost, too. It's a many-years record of dependable performance.

Grumman service starts on the drawing board, is inherent in the basic design concepts. It's part of the guts of Grumman aircraft no matter what latitude or longitude they fly. And has been for 27 years.

# SERVICE

**GRUMMAN AIRCRAFT ENGINEERING CORPORATION**
**Bethpage • Long Island • New York**
Air Superiority Fighters • Anti-submarine Aircraft • Jet Trainers
Air Transports • Nuclear Research • Aerobilt Truck Bodies
Hydrofoil Research • Grumman Boats

# Solid Fuels Contend for Long Range

**RV-A-10** (above) is largest solid propellant rocket to be flight-tested. Polaris will be larger.

By J. S. Butz, Jr.

**Huntsville**—Solid fuel rockets have moved into competitive position for use in long range ballistic missiles.

Until recently it was thought that only liquid fuel rockets would do because of premium requirements of great efficiency, high thrust and controllability. Simplicity, constant readiness, reliability, ease of handling and low cost characteristics which made solid rockets attractive in smaller missile systems were less important.

### First Major Test

Now, solid rockets are beginning to prove out in performance and efficiency comparable to liquid rockets.

First major test of solid rockets in a large missile application will be the Navy Polaris intermediate range ballistic missile. Navy dropped out of the Army Jupiter IRBM program because of the unsuitability of storing and handling high energy liquid rocket fuels on shipboard. Polaris was started because the Navy believes light-weight solid rockets now can meet the thrust termination and control accuracies required for the 1,500-mi. missile. Army also has under development a 2,000 mi. solid fuel ballistic missile designated the Big B.

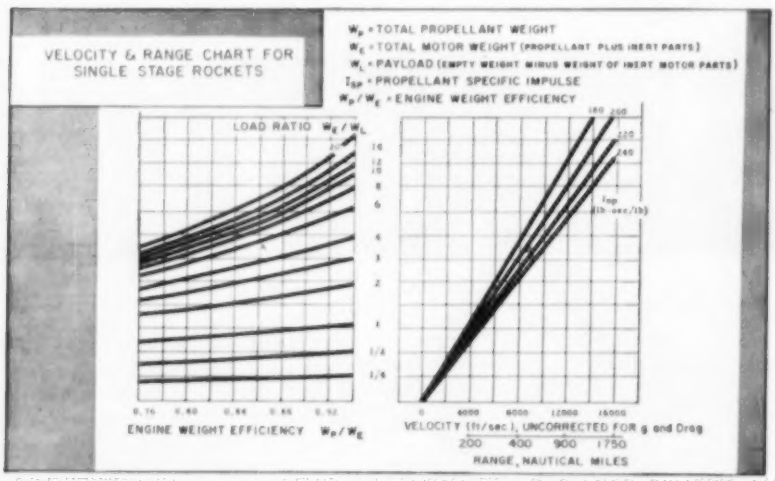
Two developments responsible for performance and efficiency of present-day solid fuel rockets are:

• **Internal-burning propellant charge.** Pioneered at the Jet Propulsion Laboratory of California Institute of Technology, the internal burning charge allows the use of a very light, thin-walled combustion chamber in place of the heavy-walled pressure vessel previously required.

• **Elasticized propellant charge.** Achieved by mixing an elasticizer with the fuel and oxidizer, the elasticized charge eliminated cracking in the charge which formerly gave solid rockets unpredictable performance and reduced structural weight by eliminating need for internal braces to support charge.

Relocating the burning surface of the propellant charge made great weight saving possible. Formerly the charges were either end burning or external burning.

They were either ignited at the nozzle and burned forward to the front end of the motor or the burning took place between the casing and the charge along the whole length of the motor. The metal pressure shell was exposed to the combustion process and had to be thick and heavy to absorb a large quantity of heat. If it wasn't heavy on an end burning charge, enough heat would be transmitted ahead of the burning surface to the front part of the case to explode the forward end of the propellant charge. On both the older types of charge there was danger of high temperatures weakening the case to the


VELOCITY & RANGE CHART FOR SINGLE STAGE ROCKETS
$W_p$ = TOTAL PROPELLANT WEIGHT
$W_g$ = TOTAL MOTOR WEIGHT (PROPELLANT PLUS INERT PARTS)
$W_L$ = PAYLOAD (EMPTY WEIGHT MINUS WEIGHT OF INERT MOTOR PARTS)
$I_{sp}$ = PROPELLANT SPECIFIC IMPULSE
$W_p/W_g$ = ENGINE WEIGHT EFFICIENCY
LOAD RATIO $W_g/W_L$
ENGINE WEIGHT EFFICIENCY $W_p/W_g$
VELOCITY (ft/sec), UNCORRECTED FOR g and Drag
RANGE, NAUTICAL MILES

**IMPORTANCE** of engine weight efficiency is indicated above. For instance, if a 12,000 fps. burnout velocity was required ($I_{sp} = 240$), the total engine weight would have to be nearly 12 times the payload if the eng. wt. eff. was 0.86. But if this efficiency was 0.92 the propulsion system would only have to be six times heavier than the pay load.

# Ballistic Role

point of failure during the firing of the rocket.

Internal burning charge is characterized by a longitudinal hole down the center of charge from nozzle to front end of the motor. Burning begins along the entire length of this hole and progresses outward to the chamber walls.

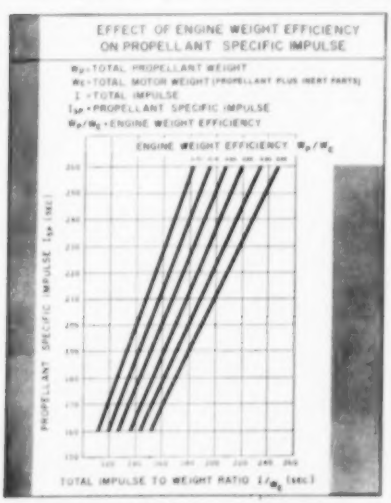
The walls are no longer subjected to combustion temperatures, as the fuel insulates them. The case then can be designed merely to withstand combustion pressure. The cold strength of the metal is utilized, and a relatively thin, light wall suffices.

### Elasticized Charge

Elasticized propellant charge was achieved by mixing a synthetic rubber with the fuel and oxidizer. This prevented the charge from cracking and bound it to the case. Successfully producing an elastic charge removed two serious objections to solid fuel rockets. One was cracking of the charge during ambient temperature changes and burning. These cracks haphazardly increased the burning surface and gave the rockets unpredictable if not explosive performance.

It also eliminated the need for internal braces to support the charge. This greatly reduced structural weight.

Elasticizer has now been developed to the point where it is useful as a fuel


EFFECT OF ENGINE WEIGHT EFFICIENCY
ON PROPELLANT SPECIFIC IMPULSE
$W_p$=TOTAL PROPELLANT WEIGHT
$W_E$=TOTAL MOTOR WEIGHT (PROPELLANT PLUS INERT PARTS)
I =TOTAL IMPULSE
$I_{sp}$ =PROPELLANT SPECIFIC IMPULSE
$W_p/W_E$ =ENGINE WEIGHT EFFICIENCY
ENGINE WEIGHT EFFICIENCY $W_p/W_E$
PROPELLANT SPECIFIC IMPULSE $I_{sp}$ (SEC)
TOTAL IMPULSE TO WEIGHT RATIO $I/W_E$ (SEC)

**INTERRELATIONSHIP** of $I_{sp}$, $W_P/W_E$, and $I/W_E$ is given above. $I/W_E$ is a primary indication of a powerplant's worth. It shows the total impulse the engine can deliver for a given total engine weight.

# Liquid-Solid Comparison

**Hypothetical solid fuel version of the V2 can be compared with the liquid fuel model which was used in service to show that modern solid propellant rockets are competitive in efficiency with liquid fuel motors.**

**The V2 is used here because complete weight figures are not available on larger, more advanced ballistic missiles. Several reasons are given in the text as to why this comparison is not intended to accomplish (and could not accomplish) anything but generally outline the efficiency possible with solid fuel rockets.**

## V2 DATA (LIQUID FUEL ENGINE)

All data is from Army records except the fuel tank weight. This was arrived at by considering 636 lb. of the total fuel tank section weight of 1,636 lb. to be external structure not directly used in the tanks and their supporting structure.

| ITEM | WEIGHT (LB.) |
|---|---|
| Fuel tanks | 1,000 |
| Motor | 2,053 |
| Motor parts (total) | 3,053 |
| Fuel (total) | 19,392 |
| Motor (total, fuel plus motor parts) | 22,445 |
| Empty (take-off less fuel) | 8,837 |
| Take-off | 28,229 |
| Payload (empty wt. less motor parts) | 5,784 |
| $M_1/M_2$ (take-off mass/empty mass) | 3.2 |
| $W_F/W_E$ (fuel weight/total motor weight) | .87 |
| $W_E/W_L$ (total motor weight/payload weight) | 3.9 |
| Thrust (includes some altitude correction) | 65,000 lb. |
| Fuel consumption | 275 lb./sec. |
| Propellant specific impulse (includes some altitude correction) | 235 sec. |

No consideration has been taken of the fuel necessary to drive the turbo pumps.

## SOLID PROPELLANT VERSION

If some high energy oxidizer such as ammonium perchlorate and a hydrocarbon fuel are used, solid charges can equal the propellant specific impulse of the V2 (235 sec. with some altitude correction).

Propellant weight would then be 19,392 lb. to equal the total impulse of the V2. Density of the solid charge mentioned above is about 110 lb./ft.[3] Since the combustion chamber would only be about 90% full to allow for the internal burning cavity, the effective density would be 99 lb./ft.[3] Volume of the tank would then be 192 ft.[3] Assuming tank diameter was approximately the same as the original V2 (5 ft.), the length of the tank is 9.7 ft.

Assuming a combustion pressure of 400 psi. and 4130 steel for the material, the wall thickness of the solid propellant motor can be calculated. (Working stress for the steel is taken as 120,000 psi.) If aluminum or titanium were used, the case would be even lighter.

Wall thickness for the cylindrical portion = Pressure x tank dia./2 x stress = 0.1 in.

Wall thickness of the spherical ends would be 0.05 in.

The 4130 steel weighs 0.29 lb./in.[3]

The weight of the case would then be about 805 lb. Assuming that the nozzle, hardware and inhibitor weigh 245 lb., the empty weight of the motor would be 1,050 lb. The solid propellant version of the V2 would then have the following weight breakdown:

| ITEM | LB. |
|---|---|
| Fuel (total) | 19,392 |
| Motor Parts | 1,050 |
| Motor (total) | 20,442 |
| Empty | 6,834 |
| Take-off | 26,226 |
| Payload (less motor parts) | 5,784 |
| $M_1/M_2$ | 3.83 |
| $W_F/W_E$ | 0.95 |
| $W_E/W_L$ | 3.54 |

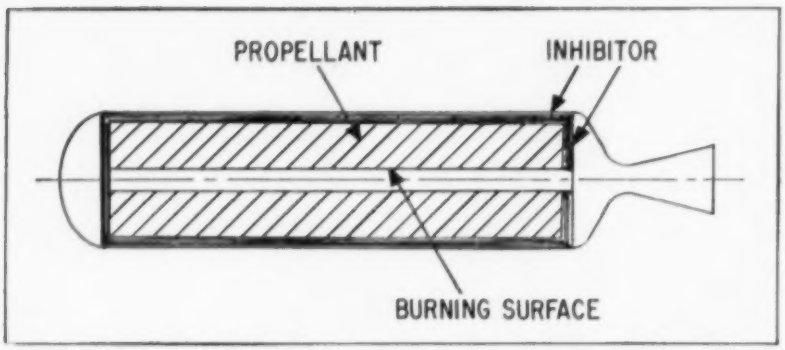



**DIAGRAM** shows internal burning, solid fuel rocket charge. Inhibitor serves as a bond between charge and thin-wall case. It resists burning, protects charge from combustion temperatures where the charge does not serve as insulation.

and is chemically added to the normal solid fuels.

Cost and ease of producing solid fuel rockets was also improved by the elasticized charge. It is now possible to pour the composite propellant charge into the thin-walled combustion chamber where it later solidifies and is ready for use.

This composite charge is usually a mechanical mixture of two chemicals: elastometric fuel and oxidizer.

### Previous Danger

Formerly, the loading or fueling of solid fuel rockets was often dangerous business.

Thiokol Chemical Corp. is credited with developing the polymer first used as an elasticizer, and with the largest high performance solid propellant rocket proven by flight test. Dr. H. W. Ritchey was honored by the American Rocket Society for his direction of this work.

The rocket was the RV-A-10, a part of the elaborate Hermes missile program. It first flew in the early 1950's and proved the feasibility of loading a large solid propellant motor with an internal-burning, elasticized, case-bonded charge. Size of solid rockets has steadily grown and units in the neighborhood of 300,000-lb. thrust have been statically fired. However, a knowledge of several factors concerning the motor and propellant is necessary to prove that such rockets can be useful in a missile.

A rigidly valid evaluation of any two powerplants can only be obtained by considering them in a complete weapon system and comparing on the basis of system performance. Shorter evaluations are possible by neglecting the interrelationship between rocket motor and guidance system, missile structure, etc. Such studies are enough to indicate the general potential of a particular powerplant.

### Affects Velocity

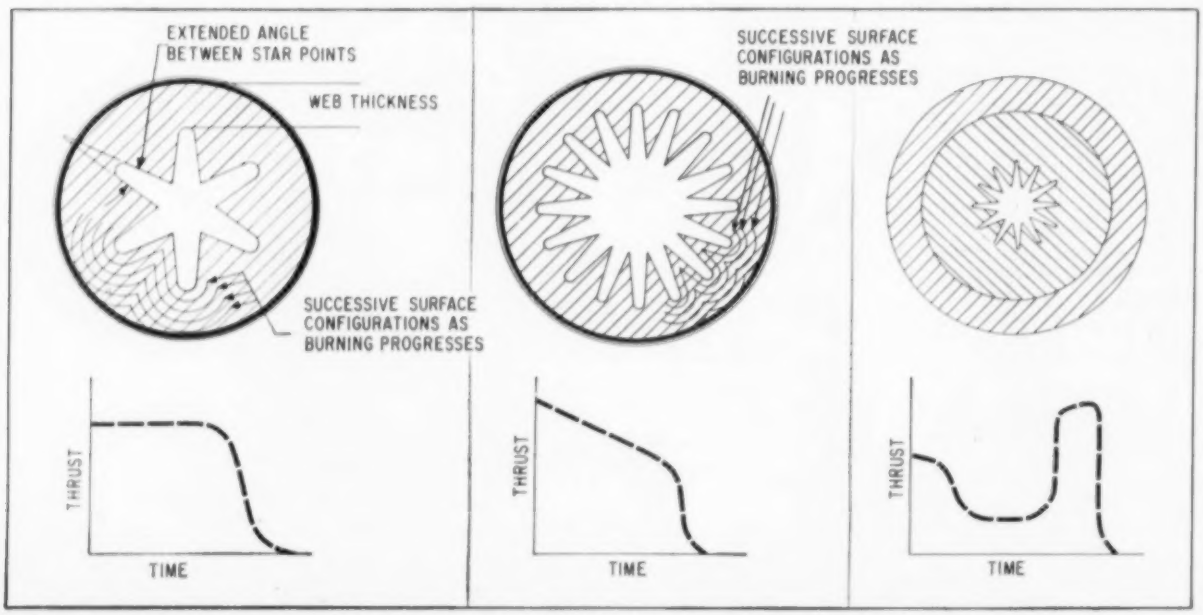
A most pertinent comparison for long range ballistic missiles is the effect of the motor on maximum velocity (neglecting atmospheric drag and gravity). Maximum velocity is a primary consideration for ballistic missiles because it (and the flight angle) determines the maximum range.

In turn, the maximum or burnout velocity depends directly on the propellant specific impulse and the logarithm of the missile mass ratio. (Mass ratio is the mass of the missile at launching divided by its mass at burnout.)

Therefore, there are two ways to increase missile range: by increasing the propellant specific impulse and/or decreasing the empty weight of the missile. Cutting down on the empty weight is more effective in increasing range for the IRBM and ICBM than increasing the specific impulse. A more detailed look at the weight breakdown for very high velocity missiles makes this clear. One of the simplest and most rapid methods has been presented by J. W. Wiggins of Thiokol Chemical Corp.

### Weight Efficiency Defined

Very high velocity missiles have a low payload (structural weight, guidance, warhead, etc.) compared to total engine weight (inert parts, tankage, propellants, etc.). The weight efficiency of the motor then becomes a primary consideration. This efficiency is defined




**AREA OF BURNING** surface governs the thrust produced by solid fuel rocket. Internal shape of propellant charge controls this area, and provides wide variety of thrust and acceleration programs. Configuration at right uses two types of propellants.

# Two new, PAYMOVER® tractors

## featuring AUTOMATIC TRANSMISSIONS

These modern packages of drawbar power bring new standards of speed, convenience and safety to the towing and spotting of aircraft and related ground-service equipment.

Automatic transmission with torque-converter is standard equipment — insures silk-smooth starts and eliminates clutching, grabbing, jerking, shifting and the high maintenance that you get with conventional "straight-stick" transmissions.

These modern tractors are built low to dodge under wings and fuselages, have low center of gravity and wide tread on dual drive wheels for stability and rigidity while pushing or pulling. They have big easy-acting hydraulic brakes and full operator visibility — even for coupling and uncoupling.

You can be sure of the design and reliability of these commercial "PAYMOVER" tractors because their military counterparts have rolled up many thousands of hours of service on both land and sea duty.

Full facts concerning these two outstanding new tractors are yours for the writing.

**PAYMOVER®**
MANUFACTURED BY
THE FRANK G. HOUGH CO. LIBERTYVILLE, ILL.
SUBSIDIARY - INTERNATIONAL HARVESTER COMPANY

### More tractor work... Less operator work

- Fully Automatic Transmission
- Smooth torque-converter pull
- No clutch maintenance
- Speeds to 20 mph.
- Low center of gravity
- Turn radius only 10 ft.
- Smooth 6-cylinder power
- Compact — only 4' 9" high, 10' long, 5' 6" wide.

**THE FRANK G. HOUGH CO.**
976 Sunnyside Ave., Libertyville, Ill.

More information please on Model T-50 and T-60 "PAYMOVER" tractors.

Name _____

Title _____

Company _____

Street _____

City _____

State _____

128

as the ratio of the propellant weight to the weight of the motor inert parts plus propellant weight ($W_p/W_g$). The ideal weight efficiency is achieved when a missile reaches the completely improbable state of carrying only propellant with no combustion chamber, nozzle, etc.

The graph on page 50 shows that burnout velocity and range are more affected by engine weight efficiency than propellant specific impulse for high velocity, high mass ratio missiles such as the ICBM and IRBM.

Despite the dearth of performance figures on all types of rocket motors, there is enough generally known information to compare roughly modern solid propellant rockets with liquid systems. In order to get some figures to work with for a complete missile, it is necessary to go back to the V2 and compare a solid fuel version with the original.

### Qualifying Factors

Many factors keep such a comparison from being in any way conclusive about solid and liquid fuel rockets in general.

Two of the most obvious:

• **Liquid fuel** rockets have been greatly improved since the V2 was designed.

• **Solid rocket** discussed here probably represents an "ideal" or ultimate design, as the casing is designed only to withstand combustion pressures. Although the internal burning charge has

## Lockheed X-7 Makes 10th Flight

Lockheed X-7 ramjet test missile with its rocket booster is shown in flight near Alamogordo, N. M. Normally one of these recoverable missiles has a life expectancy of three or four flights. This X-7, however, has completed 10 flights without damage. Recovery is accomplished with a parachute and nose spike. Each re-flight saves $350,000 in the ramjet test program, according to Lockheed.


▲

**ENGINEERS**

*. . . cross new frontiers in system electronics at THE GARRETT CORPORATION*

Increased activity in the design and production of system electronics has created openings for engineers in the following areas:

*ELECTRONIC AND AIR DATA SYSTEMS* Required are men of project engineering capabilities. Also required are development and design engineers with specialized experience in servo-mechanisms, circuit and analog computer design utilizing vacuum tubes, transistors, and magnetic amplifiers.

*SERVO-MECHANISMS AND ELECTRO-MAGNETICS* Complete working knowledge of electro-magnetic theory and familiarity with materials and methods employed in the design of magnetic amplifiers is required.

*FLIGHT INSTRUMENTS AND TRANSDUCER DEVELOPMENT* Requires engineers capable of analyzing performance during preliminary design and able to prepare proposals and reports.

*FLIGHT INSTRUMENTS DESIGN* Requires engineers skilled with the drafting and design of light mechanisms for production in which low friction, freedom from vibration effects and compensation of thermo expansion are important.

*HIGH FREQUENCY MOTORS, GENERATORS, CONTROLS* Requires electrical design engineers with BSEE or equivalent interested in high frequency motors, generators and associated controls.

*Send resume of education and experience today to:*
*Mr. G. D. Bradley*

THE GARRETT CORPORATION

9851 S. Sepulveda Blvd.
Los Angeles 45, Calif.

DIVISIONS:
AiResearch Manufacturing Los Angeles
AiResearch Manufacturing Phoenix
AiResearch Industrial
Rex—Aero Engineering
Airsupply—Air Cruisers
AiResearch Aviation Service

# Electronic Cooling Package...by AiResearch

**SPECIFICATIONS OF TYPICAL AIRESEARCH COOLING PACKAGE**

| | |
|---|---|
| Air Flow | 60 CFM |
| Fan Air Inlet Pressure | 18 PSIA |
| Fan Pressure Rise | 1.2 inches water |
| Heat Exchanger Pressure Drop | 1.0 inches water |
| Liquid | Water Methanol (70% Methanol) |
| Liquid Flow | 0.4 GPM |
| Heat Rejection* | 300 Watts |
| Fan Power | 30 Watts, 110 V., single phase, 400 cycle |
| Package envelope dimensions | 7 x 6 x 3 inches |
| Package wet weight | 2.5 lbs. |

*Assumes Class A (85°C.) electronic components, liquid inlet temperature to heat exchanger, 55°C. Includes heat from fan motor.

This high performance AiResearch package cools sealed and pressurized electronic equipment. The fan circulates air through the liquid cooled heat exchanger and over electronic components in a hermetically sealed module. Air cooled units are also available. Fan and heat exchanger are designed, built and packaged by AiResearch for matched performance. Package size is tailored to your individual cooling requirements.

The Garrett Corporation, through its AiResearch Manufacturing divisions, is an industry leader in components and cooling systems for aircraft, missiles and nuclear applications. This wide experience is now being offered to the electronics industry to provide a cooling package to meet any cooling requirement. Send us details of your problem or contact the nearest Airsupply or Aero Engineering office for further information.

**THE GARRETT CORPORATION**

AiResearch Manufacturing Divisions

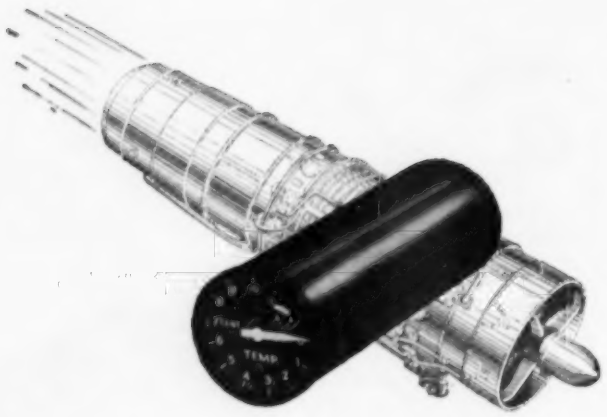
*Los Angeles 45, California • Phoenix, Arizona*

**AERO ENGINEERING OFFICES:**

MINEOLA • ATLANTA • BALTIMORE • BOSTON • CHICAGO • CINCINNATI • COLUMBUS
DETROIT • INDIANAPOLIS • PHILADELPHIA • ST. LOUIS • SYRACUSE • WINTER PARK

**AIRSUPPLY OFFICES:**

BEVERLY HILLS • DENVER • FT. WORTH • KANSAS CITY • SAN DIEGO • SAN FRANCISCO
SEATTLE • TULSA • WICHITA



This instrument makes it possible for the jet pilot to get maximum performance and longer life out of today's jet engines. It's Honeywell Aero's transistor Temperature Indicator of the null balancing type. Hermetically sealed in a single package, it has 1200°C. range with better than ± 5°C. accuracy. Available now, Honeywell's Temperature Indicating System is already in use measuring exhaust gas temperature or turbine inlet temperature in many of America's most advanced jet fighters and transports.

**Honeywell**

H Aeronautical Division

brought this "ideal' close to realization, other loads must undoubtedly be considered.

Only purpose of the comparison is to provide a few numbers to generally orient the problem and to show that solid fuel rockets are in consideration, from the standpoint of efficiency, for use in very high velocity missiles.

A table with the article gives the pertinent information on the V2 and the calculations and assumptions used to arrive at the corresponding data for the solid fuel version.

These calculations show that the weight efficiency of the original V2 was .87 and that the weight efficiency of the solid version could reach .95. It is hard to imagine a liquid fuel rocket with its pumps, injectors, tanks, etc., approaching an engine weight efficiency of .95.

Reference to the graph on page 50 indicates that the solid version would go about 1,000 ft. per sec. faster at burnout than the service V2. It is also clear from the curves that high weight efficiency becomes more critical as the mass ratio and $W_g/W_L$ increase, which they must for very high velocity vehicles.

### Specific Impulse Role

Specific impulse by itself does not have as important an influence on range for high mass ratio missiles as it did for the relatively low velocity rockets of the past. In many cases high specific impulse requires heavier engines which operate at higher temperatures and pressures.

A quick way to tie specific impulse to weight efficiency is to relate them to the total impulse-engine weight ratio (see graph page 51). This ratio is a generally used factor of merit in the propulsion field. It will equal the propellant specific impulse when the engine weight efficiency is 100%—an ideal situation when an engine is all propellant with no hardware, combustion chamber, nozzle, etc.

Total impulse-engine weight ratio for the service V2 was 200 compared to 225 for the solid fuel version.

Another benefit of the solid version is the greater density of the fuel. The solid fuel motor mentioned here was less than half as long as the liquid unit with its fuel tanks. Savings in length could have been used to cut down frontal area and give a smaller, lower drag missile.

### Weight Saving

Solid fuel rockets have another major advantage, in that their casings may be tied into the missile structure and used to carry loads. The high performance X-17 nose-cone test missile uses this type of design. The combustion chamber walls of its engines serve as the outer skin as well as carrying accelerative and airloads, etc. Winged missiles such as the Hawk surface-to-air weapon tie the main lifting surfaces to the case as well.

Careful design then allows essentially double use of structural metal—to carry loads while containing the rocket motor combustion—and results in a reduction in missile empty weight.

Other major problem facing solid fuel rockets in ICBM and IRBM use is the very accurate programing and termination of thrust. Progress in this field is obscured by one of the tightest security orders in the country.

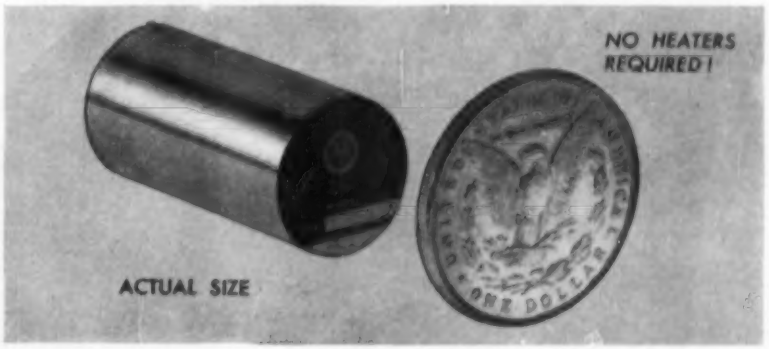
Basic problem though, is well known. Thrust and the flight vector must be varied precisely so that when the missile reaches an exact point in space at a prescribed velocity, the thrust will be extinguished.

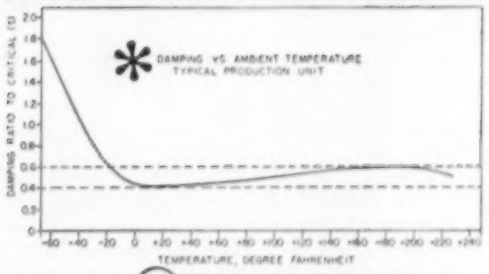
### Planning Important

The problem is completely analogous to a cannon firing a shell. The impact area of the shell is predictable because its velocity and angle of flight are known as it leaves the cannon. For the ballistic missile, the point at which the motor stops or burnout occurs corresponds to the cannon muzzle. The velocity and angle of flight for an ICBM must be exactly as planned at burnout


The SUBMINIATURE PRECISION RATE GYRO

With Constant Damping Over A Wide Temperature Range *




Check these unusual, high standard specifications

1. Constant damping (0.5 ±0.1 critical from −20° F to +220° F)
2. Subminiature size (0.937" dia. x 2.0" long)
3. Outstanding reliability (exceeds requirements of MIL-E-5272A Specs)
4. High resolution
5. Extremely high natural frequencies (up to 43 cps for 1 radian/sec; lower if desired)
6. Variety of motor characteristics available (3φ, 2φ, or split 1φ; 26V or 6.3V; 400 cps)
7. Wide variety of sensing ranges (from 0.5 radians/sec to 20 radians/sec, full scale)
8. Light weight; 3.7 oz.

DETROIT CONTROLS

Division of AMERICAN-Standard

100 Morse Street, Norwood, Massachusetts

# Great advances in design . . .

## NEED THE ADVANCEMENT IN WEAR RESISTANCE PROVIDED BY FLAME-PLATING BY LINDE

Lockheed's F-104A Starfighter, newest weapon of the Air Force, is the most advanced airplane of its type. To give them the greatest possible resistance to extreme conditions, bearing surfaces *(arrows)* of hot air valves used in the F-104A are Flame-Plated with tungsten carbide. Flame-Plating provides the wear-resistant coating needed to withstand the high unit loading and temperature extremes jet plane parts undergo.

Stratospheric altitudes . . . supersonic speeds . . . extreme temperatures subject jet plane parts to almost incredible conditions of heat and abrasion. To assure perfect operation in all circumstances, bearings of hot air valves in the Starfighter are Flame-Plated. A tungsten carbide coating, applied by LINDE's unique method, is the only material tried that successfully eliminated galling and provided a low coefficient of friction over the required service life of the part. With the part Flame-Plated, practically no wear occurred. This LINDE process is now a regular production procedure.

Flame-Plating is LINDE's special process for protecting metal parts from wear, abrasion, and fretting corrosion. Tiny particles of tungsten carbide or aluminum oxide are literally *blasted* onto the metal surface. Since the temperature of the part being coated seldom exceeds 400 degrees F., there is little or no risk of changes in its shape or metallurgical properties. Flame-Plated coatings can be applied from .002 to .010 inches thick, and used as coated or finished to 0.5 microinches rms. Practically all metals can be Flame-Plated—aluminum, magnesium, molybdenum, titanium as well as copper and steel.

Your own design may be improved by Flame-Plating. Find out how, by writing for a copy of the booklet "Flame-Plating," F8065. Address Flame-Plating, Dept. AW-11. LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.
*In Canada:* Linde Company, Division of Union Carbide Canada Limited.

Linde
TRADE-MARK
UNION CARBIDE

The terms "Linde" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

if the missile is to strike its target.

A throttlable motor is ideal to meet these conditions and that is what solid fuel designers probably are striving for. However, it is now possible to program the thrust of solid fuel rockets over a wide range simply by altering the shape of the hole or holes in the internal burning charge.

Thrust depends on internal pressure which is controlled by the burning surface of the charge. Altering the geometry of the hole in the charge can hold the area of the burning surface to close tolerances. (See page 52.)

This method of thrust and acceleration programming is fine for most missile applications, but is probably not accurate enough for the ICBM and IRBM.

Since thrust depends on combustion pressure, some other means than charge geometry will have to be found to control this pressure.

One fact, which has been published in text books, aids the designer in achieving a sudden and complete cessation of thrust. Most propellants require a rather high minimum combustion pressure (several atmospheres). Any large and sudden increase in exhaust area when flying at altitude would stop combustion and terminate thrust. This would seem to be largely a mechanical design problem of providing a sizable opening to vent rapidly the combustion chamber to the atmosphere without producing some asymmetrical thrust.

## Small Rocket Motor Delivers 40-lb. Thrust

One of the smallest solid propellant rocket motors is called PET (propulsion, experimental test). Similar to the spin rockets on third stage of Vanguard, it is now commercially available.

Unit weighs .6 lb., is 1.5 in. in diameter, 4.75 in. long and delivers 40 lb. of thrust for one second at sea level pressure and temperature.

Atlantic Research Corp. of Alexan-


MUELLER BRASS CO.

ALUMINUM AIRCRAFT FORGINGS

PRECISELY FORGED TO ENGINEER'S SPECIFICATIONS PRODUCED AND DELIVERED ON SCHEDULE . . . UNDER EXACTING METALLURGICAL CONTROLS

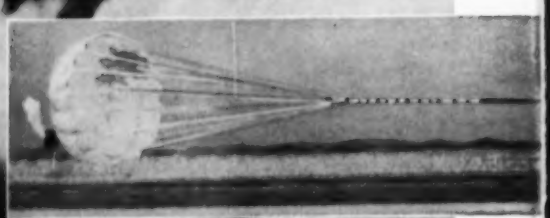
Mueller Aluminum forgings for high tensile strength!
Mueller Aluminum forgings for light weight!
Mueller Aluminum forgings for less scrap loss!
Mueller Aluminum forgings for better machinability!
Mueller Aluminum forgings for resistance to corrosion!
Mueller Aluminum forgings for high density!
224

Write today for your copy of the engineering manual FORGINGS. Packed with photos, specifications, and valuable data on Mueller Brass Co. quality forgings of brass, bronze, and aluminum.

MUELLER BRASS CO.

PORT HURON 39, MICHIGAN

# ROUND-TRIP MISSILES ANSWER



ENGINEERS' QUESTIONS AT VOUGHT

# "Old Indestructible" Paid a $3 Million Dividend in Data

When a missile can be flown . . . recovered . . . and flown again, it becomes an acquaintance. When a single *Regulus I* missile came home 15 times, it got a name.

"Old Indestructible" began her career by returning flight test information to Vought engineers. The missile gave the acid test to new launching methods, guidance principles, performance maximums and telemetering channels. Three flights, and the bird had paid for herself in fat data installments.

When the missile had been picked clean by Vought reliability and systems men, she joined the Navy. Fleet submariners and surface seamen were ready to operate *Regulus* as a target drone and nuclear weapon. Old Indestructible was chosen to teach them.

The missile qualified six Navy teams in *Regulus* tactics, logistics and maintenance. Repeated launchings at 70,000 pounds thrust stretched her airframe. Flight and ground-run time on some components mounted above 1,000 hours. Operationally, however, the missile was sound when time came for her 16th and final flight, a shipboard launching in a simulated nuclear attack.

Thanks to Old Indestructible's dogged returnability, Vought engineers could design its reliability standards into every Navy-bound *Regulus*. Results were unprecedented. With the Fleet, *Regulus I* has completed well over 600 flights with outstanding on-target success probability.

Today, Vought missile men are using the recovery concept to foolproof a mightier missile. Their *Regulus II* has completed 20 flights to date. Significantly, six of these flights were made by one missile.

**Swift, versatile Regulus II can strike from land or sea.**

Nuclear subs, surface ships, shore batteries . . . they will all get the supersonic striking power of Vought's new *Regulus II*. This missile system weds marine and missile engineering, test range and shipyard, nuclear power and inertial guidance. It's a uniquely interesting and rewarding project — and one you can join through new, select openings.

*For details on current openings in this and other Vought projects, write to:*
*C. A. Besio, Supervisor, Engineering Personnel, Dept. A-19*

CHANCE VOUGHT AIRCRAFT
INCORPORATED · DALLAS, TEXAS

for
analog computer
readout:

modern, compact, mobile

# SANBORN

## CONSOLE RECORDING SYSTEMS

Up to eight problem variables can be recorded in inkless, permanent, rectangular-coordinate tracings – with Sanborn's improved six- and eight-channel 156-, 158-5490 Console Systems. Less than four feet high and about two feet in width and depth, these Systems are completely mobile and designed for maximum operating convenience. Controls and indicators on the sloping top panel include individual-channel attenuation, position, balance, sensitivity and stylus heat adjustments; switch for turning off B + of output amplifiers; chart drive motor switch (can also be remotely controlled); code marker and/or one-second interval timer stylus switch. The Recorder unit, either six or eight channels, features paper loading from the top, and nine precisely controlled speeds from 0.25 to 100 mm/sec. Four dual-channel DC Driver Amplifiers of current feedback design are housed below the Recorder, and are mounted on a chassis which may be withdrawn for inspection.

Electrical specifications of the Console Recording Systems include a basic sensitivity of either .01 volt/chart division (5490 types) or 0.1 volt/chart division (5495 types); linearity of 1%; drift less than 1/2 chart division/hour (5490), less than 1/20 chart division/hour (5495); flat frequency response to 20 cps, down 3 db at 60 cps for all amplitudes to 5 cm peak; either single-ended or push-pull input signals of 5 meg. impedance (each input lead to ground).

A useful companion instrument is the new Sanborn Model 183 Programmer, designed to provide a connecting link between an analog computer and the Console Recording System. Shown mounted at the top rear of the Console, the Programmer operates the Console in the following automatic sequence: turns recorder drive on – feeds calibration signals to all channels – reads initial DC levels of computer – closes contacts to start computer problem – records computer output for a preset chart length – turns off recorder drive and resets itself for another cycle.

Further technical data, prices and delivery information – on the 5490/5495 Console Recording Systems and two- to eight-channel 5475/5480 Systems are available on request from your Sanborn Sales-Engineering Representative or the Industrial Division in Waltham.

40th ANNIVERSARY 1917–1957 SANBORN COMPANY

**SANBORN COMPANY**
INDUSTRIAL DIVISION
175 Wyman Street, Waltham 54, Massachusetts

## Fairchild Tests Turboprop Freighter Model

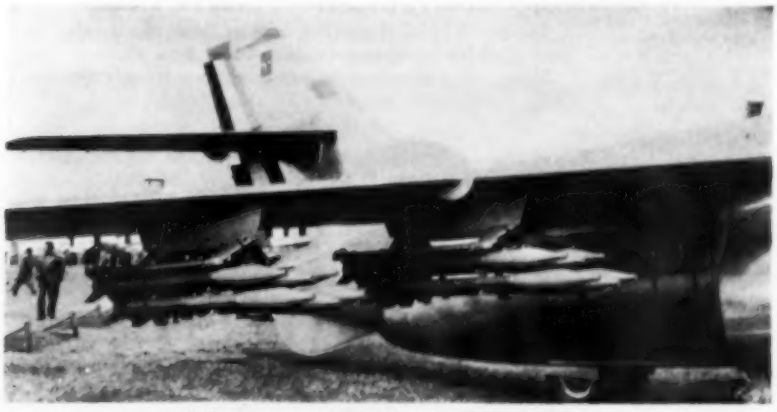
Scale model of Fairchild M-253 Turbo-Boxcar is readied for test in University of Maryland windtunnel. Company plans the 75,000-lb. gross weight pressurized freighter as a low-cost follow-on transport for its C-123 Provider, expects to have a prototype flying in mid-1958 (AW May 13, p. 69). Powerplants are four Lycoming T55s. Turbo-Boxcar is designed to carry more than 30,000 lb. payload over short ranges, more than 20,000 lb. at normal range of 1,500 mi. Cruise speed would be about 250 mph.

dria, Va., is making the rocket motor. Potential applications for the rocket as seen by the company include acceleration of small masses, packaged fast-response, short-time thrust services, short-time exposure of materials to rocket blast, and retro and spin functions on larger missiles and rockets.

Ignition is accomplished by an integral, electric igniter. The rocket motor is delivered sealed, weatherproofed and ready for firing.

## Republic Will Develop Army Surveillance Drones

Republic Aviation Corp. will develop combat surveillance drones for the Army, one model for immediate availability under a $1.7 million contract, and a more advanced model for future use under a $3 million contract. Both types will be zero-length launched and recoverable, and first will be propeller driven. Fabrication of first has begun.



## Vautour Rocket Close-up

Sud Vautour ground attack version carries air-to-ground unguided rockets in Christmas tree installation under wings. Ventral fin is visible below and behind rockets.


# Precision manufacture of compressor blades in experimental quantities

*by*
**Ernest Neumann**
*President*
*Tyron, Inc.*

***Current programs*** for the design and prototype production of small gas turbines reveal special problems associated with the reduced size of these engines. Performance and efficiency requirements are more stringent and there is a corresponding tightening of dimensional tolerances to meet the new standards.

***The closer tolerances*** are most evident in compressor blades. Previous methods of blade manufacture were designed around the tolerances of larger jet engines and are not applicable to the smaller counterparts. Here at Tyron we have specialized in developing new techniques particularly applicable to the precision manufacture of small compressor blades. We are able to produce these blades with airfoil envelope tolerances of ±.0015 and tangent angle tolerances of ±15 minutes (Fig. 1).

*Fig. 1 Small gas turbine compressor blades*

***For the past year*** Tyron has concentrated on the manufacture of compressor blades in experimental and pre-production quantities. We have developed special blade forming machinery which, combined with the long experience of our people in the design and manufacture of blades and airfoils, enables us to produce to exceptional dimensional and finish tolerances in minimum time and at a cost approaching that for similar quantities of larger blades.

***The familiarity*** of our engineers with the basic problems of blade design enables us to be particularly helpful to the engine designer, frequently resulting in a more satisfactory product at lower cost.

**OTHER COMPLEX SHAPES**

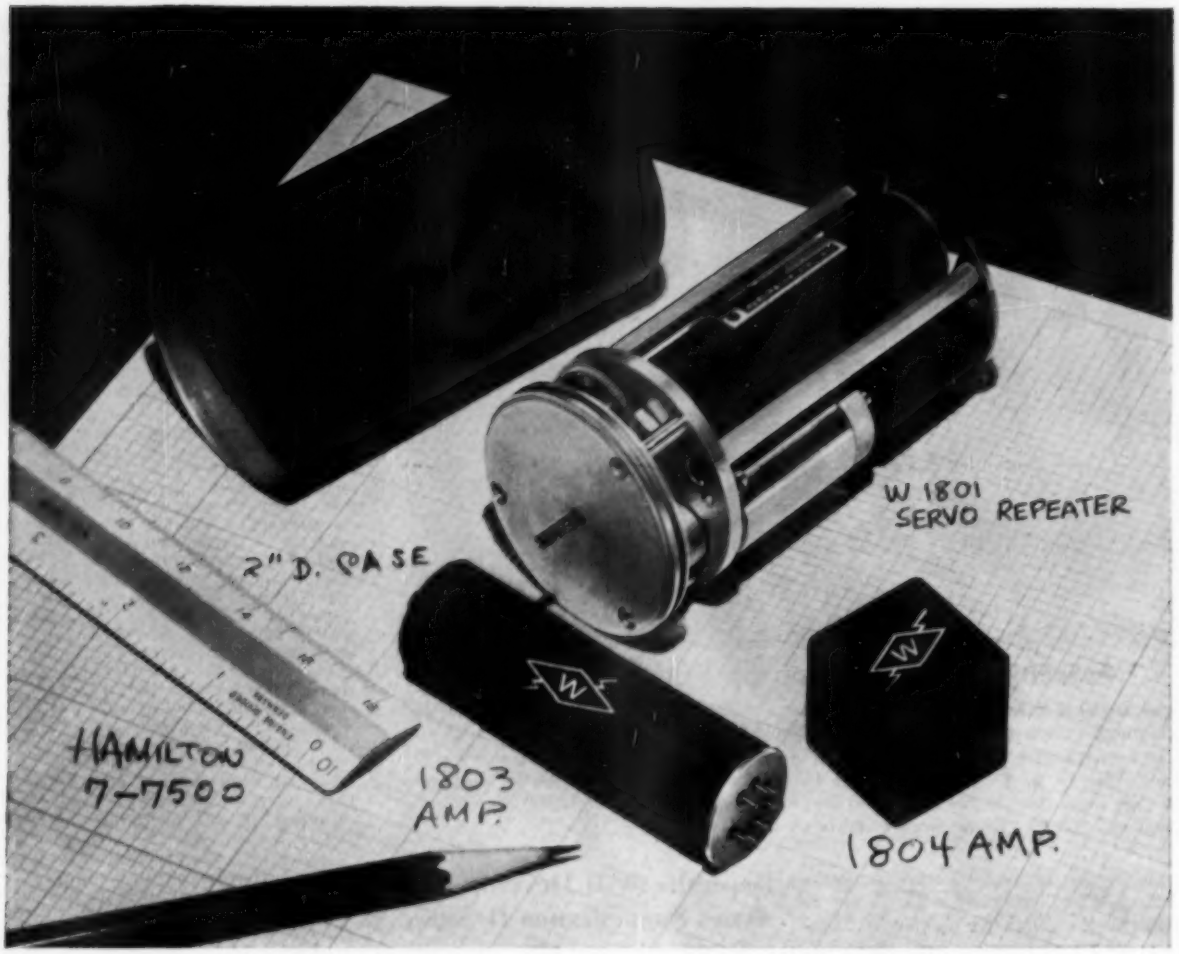
Our special machinery and manufacturing techniques also make it possible for us to machine other intricately shaped parts for the newer engines and accessories. Here again, our experience in producing many complex parts (Fig. 2), requiring critical dimensional tolerances may be of interest.

*Fig. 2*

*Intricately shaped machined parts.*

We welcome opportunities to discuss problems in forming blades or other small machined parts whose geometry or dimensional and finish requirements present difficulties. Your inquiry is invited.

**TYRON, INC.**
42 Brookford St., Cambridge 40, Mass.
*Telephone: TRowbridge 6-8090*




# Waldorf announces an important new design concept... MICROMATION

MICROMATION—the logical result of Waldorf's unique talent for compressing more performance and reliability into less space.

MICROMATION—making use of Waldorf's credo of less space, less weight, less heat, less power, to provide just the first of a series of related components and assemblies for servo and computer applications.

MICROMATION now makes available—

Model W1801—Transistorized Servo Repeater System; size 2" Dia. x 4" long, weight 13 oz. including amplifier and power supply.

Model W1803—Transistorized Servo Amplifier; size 13/16" Dia. x 2¾" long, weight 2 oz.

Model W1804—Transistorized Servo Amplifier; size 1" x 1" x 1".

In the housing of the W1801 Servo Repeater System illustrated are all the electronic and electromechanical components to develop shaft position output with torque exceeding 20 oz.-in. Static accuracy is within 0.1° of input from synchro or transducer. Velocity constant is 60 $sec.^{-1}$. Requires only 115V, 400 cps supply. Other configurations are available to suit your requirements. Uses include control of positioning devices, valves or computer elements. May also be used as aircraft indicators. Meets military specifications.

Model W1803 Amplifier as used in the W1801 Servo Repeater is designed for minimum mounting surface—13/16" Dia.

Model W1804 Amplifier is identical electrically but packaged for minimum volume—1" x 1" x 1".

Both accept synchro, potentiometer, or other transducer data. Both drive size 8 or size 10 motors.

*Interested?*

If these product improvements—or the coming innovations in MICROMATION—integrators, differentiators, coordinate-converters, vector solvers and power supplies challenge your imagination, why not ask for further data?

Waldorf

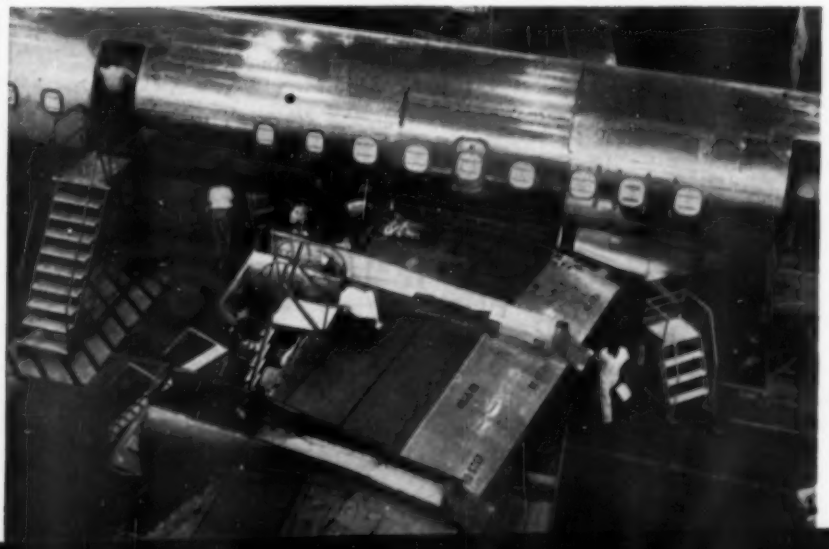
INSTRUMENT COMPANY

Division of F. C. Huyck & Sons

DEPARTMENT EC-41 · ELECTRONICS DIVISION · WALDORF INSTRUMENT COMPANY · HUNTINGTON, LONG ISLAND, NEW YORK

**FIRST ELECTRA** is completed structurally in Lockheed Aircraft Corp.'s Burbank assembly hangar with addition of empennage. Plane is scheduled for first flight in January. Another of the turboprops, expected to be first in commercial service after delivery to Eastern Air Lines next fall, is now in fuselage mating dock.

# Lockheed Completes Structural Assembly Of First Electra



**EMPENNAGE** of first Electra is shown in closeup (above). In earlier production stage, the turboprop's 99-ft. wings are mated to 128-in-wide fuselage (left). Workmen inside the fuselage are building up wiring, insulation, electrical and hydraulic equipment. Wings are integrally stiffened to minimize fuel leakage. This Electra is scheduled for delivery to Lockheed's engineering flight department in December. Another, now in the fuselage mating dock, will be delivered to Eastern Air Lines next fall and is expected to be the first Electra in commercial service. Lockheed has sold 141 Electras.

Luxury air travel at thrift fares is offered by Continental Airlines' Club Coach DC-7B's. They fly fast schedules between Chicago, Kansas City, Denver, and Los Angeles.

***Says*** **William A. Weeks, Assistant Director of Communications, Continental Airlines Inc.:**

# "Electronic equipment in Continental's Club Coach planes is extra-dependable because of G-E 5-Star Tubes!"

"Everything about our new Club Coach DC-7B's is superior. That includes communication facilities, and radar and other navigation instruments. Their reliability helps us keep the fast, on-time schedules that are a part of Continental's Gold Carpet service.

"One reason—and a big one—for the dependable performance of our electronic equipment, is tubes such as the one I'm pointing to: 5-Star Tubes built by General Electric for air, military, and industrial sockets requiring highest tube reliability.

"Their failure rate is extremely low, and they outlast regular tubes by a wide margin. Continental's records prove both statements. Also—due to their trustworthiness—5-Star Tubes help keep our costs down. They cut our need to pull faulty electronic equipment and send it to our Denver shops for overhaul. This is expensive in operating dollars as well as in flight delays.

"Continental looks on General Electric 5-Star Tubes as an important part of its effort to give the public the newest and best in air travel."

* * *

Benefit from Continental Airlines' favorable experience! Your local G-E tube distributor stocks 5-Star high-reliability tubes. Phone him! *Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Kentucky.*

*Progress Is Our Most Important Product*

GENERAL ELECTRIC

161-1PA

# Aircraft Operators Are Warned To Select Overhauls Carefully

Dallas—Joseph M. Chase, of the Flight Safety Foundation, advised aircraft operators here to "make price your last and not your first consideration" in selecting suppliers and overhaul agents.

Speaking at the Southwest Airmotive-Pratt & Whitney Operation and Maintenance Forum here, Chase told the operators to make their primary aim a good overhaul, not a cheap one, to protect themselves from the dangers of bogus parts.

### Bogus Part Dangers

Citing the dangers of using bogus parts, Chase advised operators to buy parts only from a prime manufacturer, an authorized dealer or a reputable maintenance agency. For overhaul work done by a repair station, he counseled extreme care in selection.

Chase suggested that, in judging repair stations, operators look for a Civil Aeronautics Administration approved repair station certificate as a measure of facilities and personnel. Factory approvals and letters of commendation also were cited as handy yardsticks of reliable repair stations.

Contamination of the stream of aircraft parts by bogus parts is serious for these reasons, he said:

• **Bogus parts can** endanger flight. Chase cited the example of a commercial cargo transport that crashed and burned because of the use of various bogus parts in the elevator tab controls.

• **Airworthiness certificate** of an aircraft can be suspended or revoked if bogus parts are used in its repair, maintenance or overhaul.

• **Some bogus parts** are nearly impossible to detect without extensive testing, making them difficult to eliminate through inspection. Some bogus parts carry inspection marks and part numbers of genuine parts and are packaged like the originals.

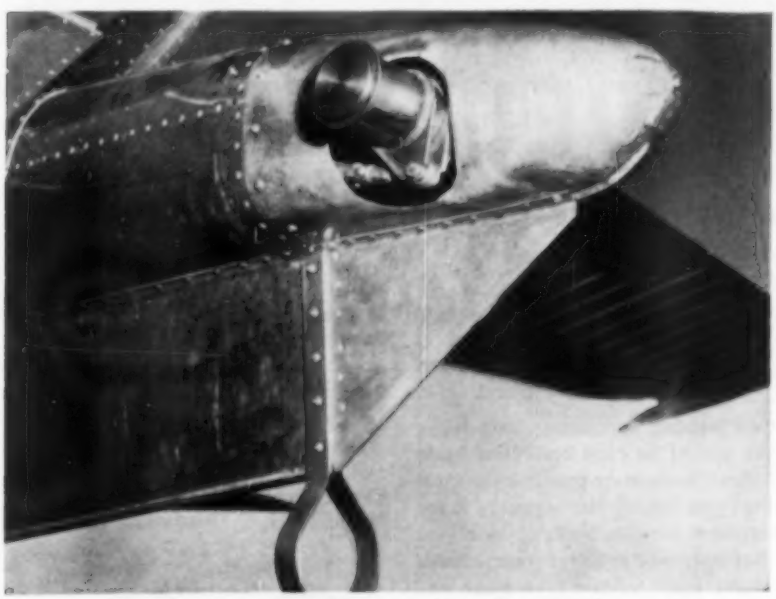
### How Bogus Market Began

Problem of bogus parts arose after World War II, according to Chase, when large numbers of aircraft engines were declared surplus and manufacturers quit making replacement parts for some of them.

As surplus engines and parts came into short supply, the bogus part problem was born.

Chase said the problem was aggravated by the fact that many new, genuine surplus parts lost their identity during the process of sale and shipment, making them unacceptable to CAA. This reduced the supply of usable parts and raised prices.

These orphaned parts found their way back into the market, according to



## Rotation Varies Jet Control

Close-up of Bell X-14 tail shows one of the three compressed air jets used for low speed flight control. Identical in appearance to the control jets used on Bell's first VTOL, reaction force is varied by rotating sleeve with bell crank visible inside fuselage opening.

# PUMP PRIMERS

by
Arthur A. Nichols

***Low weight, high performance and unusual adaptability to space and geometry of housing structure make Gerotor pumps ideal for gearbox lube and scavenge service.***

Engineers concerned with drives, auxiliary power sources, gear boxes and various transmission design problems involving pressure lubrication have found Gerotor type pumps extremely useful in their attempts to hold weight down and achieve maximum compactness with high service reliability.

Fig. 1 Integral Transmission Pump

**Several helicopter** firms and their gear suppliers, for example, are using our pumps because they combine so many useful advantages of importance in aircraft design. The Gerotor pump is a positive displacement type, delivering a predetermined amount of fluid in direct proportion to speed. It is a form of internal gear pump — simple and compact in basic design, (has only two moving parts). It is lightweight, valveless, provides exceptional performance and has low wear over a long service life. It is balanced and extremely quiet in operation.

**Unlike conventional** gear pumps the Gerotor needs only a single shaft. Both elements are substantially concentric to it and are mated to provide continuous, fluid-tight engagement without the crescent structure necessary in other internal gear pumps. Porting and plumbing are completely flexible in location. Further, Gerotor elements can be stacked along a single shaft and mounted on a single AN pad to perform multiple pump functions: lube, scavenge, boost, etc. *(fig. 1)*. Such compactness allows pump configuration to be adapted to the gear box

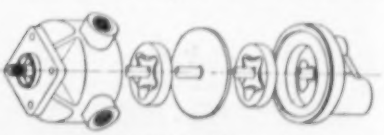


Fig. 2 Multiple Element Pump

geometry. It can be "submerged" in a sump which frequently may be part of the pump housing, *(fig. 2)*.

**Valveless design** insures absence of mechanical troubles and wear problems inherent in valve construction.

**Technical information** plus complete custom engineering and precision manufacturing facilities are available to help you obtain the right pump to meet your specifications. Your inquiry is invited.

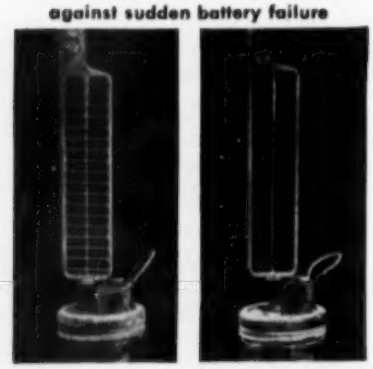
**W. H. NICHOLS CO.**
48 Woerd Ave., Waltham 54, Mass.

*Photo courtesy SPS*

# FLIGHT DELAYED!

## *An Exide battery could have prevented it*

**How Exide batteries protect you against sudden battery failure**



Silvium alloy grid after corrosion test

Non-Silvium alloy grid after same test

The plane was on the ramp . . . waiting for clearance. Then the battery failed . . . suddenly, without warning . . . because corrosion had weakened the grid.

Now you can be protected from delays like this, at no extra cost. New Exide Aircraft Batteries are practically immune from grid failure. The secret lies in the corrosion resistant Silvium* metal—an alloy designed especially for use in Exide battery grids. Silvium grids resist corrosion so well that they generally outlast the battery. So you enjoy new freedom from one possible source of takeoff delay.

Take advantage also of the extra safety protection available in these new batteries. And, at the same time, get the superior capacity and life potential resulting from the ultra-fine active material and new, 25% more porous separators. Call your nearby Exide sales office. Or write Exide Industrial Division, The Electric Storage Battery Company, Phila. 2, Pa.

**U.S. Patent*

Exide®

Chase, and helped create a new market "where integrity and responsibility are not requirements for doing business and where the only questions asked have to do with payments."

From this traffic in genuine but unidentified parts, Chase said, the market shifted to "modifying" parts without benefit of engineering data and then to outright counterfeiting.

Chase pointed out that CAA provides for manufacture of parts through the holder of the type certificate and through approved parts manufacturers.

He said the weakness in the system is that it was devised for "the guidance of honest people and not for the control of the dishonest." Power of CAA to suspend and revoke certificates and to cancel approvals doesn't worry dealers in bogus parts, he said.

One contribution to the bogus parts traffic came from manufacturers' practice of identifying rejects by dabbing them with paint. When these rejects were sold for scrap, bogus parts dealers found it easy to remove the paint and sell them. Now, most manufacturers are mutilating rejects to cut down this source.

Chase observed that there are reports the military has not been very cooperative about scraps and rejects. "They are said to be too busy to spend time mutilating worthless material," he said.

## Navy Amends Lease For Engine Plant

Navy has amended lease for the Naval Industrial Reserve Aircraft Plant at Kansas City to permit Westinghouse to carry on subcontract work in all areas of the plant not required for engine and parts production for BuAer.

The plant is leased to Westinghouse for its aviation Gas Trubine Division and the company subleases parts of it to Bendix and to a consulting engineer firm.

Several provisions of the 5-year lease are advantageous to the jet engine division from the standpoint of commercial work, W. W. Smith, Westinghouse vice-president and manager of the division, said.

"New pricing procedures have been established which will improve the division's competitive position appreciably," Smith said. "While we have enjoyed a good volume of subcontract work during the past year, the new agreement will enable the division to negotiate on a more competitive basis for commercial work from other divisions of Westinghouse as well as other companies."

The new agreement transfers administration of the lease from the Bureau of Yards and Docks to the Bureau of Aeronautics.

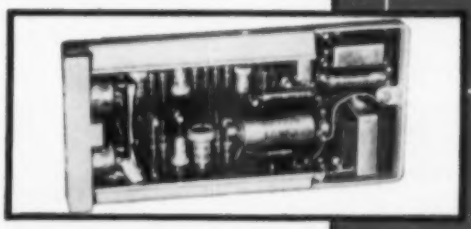
NEW SERVO AMPLIFIERS DEVELOPED AT DAYSTROM INSTRUMENT

Typical items developed by Daystrom Instrument in conjunction with its systems work are these miniature servo components. Additionally, Daystrom offers custom designed units and servo sub-systems for data processing, automation systems, fire control systems, simulators and other applications.

**3 WATT,**

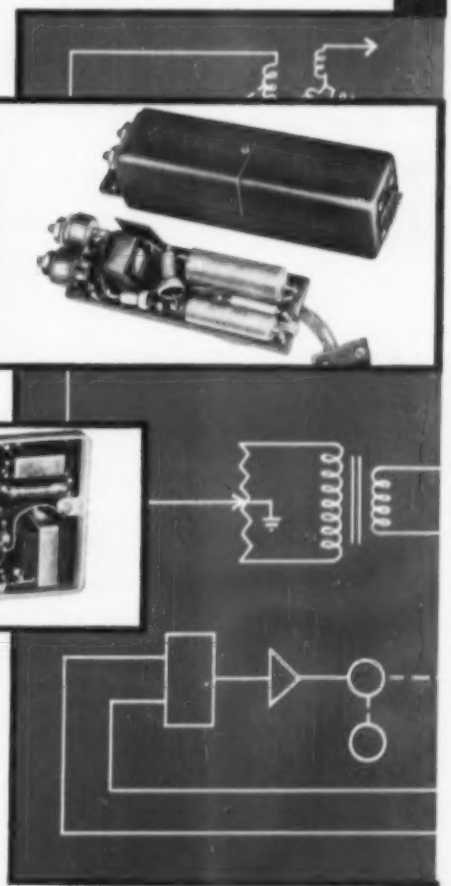
**all transistorized designed to operate 400 cycle motors with 35 volt center tapped control windings. Overall Dimensions—1.30 inches x 1.30 inches square; Length 5.50 inches . . . Weight 6.5 ounces, Input Impedance 10K ohms, Gain 350, Power Supply 28 VDC. Amplifier package is plug-in type using a Winchester Type SMRE7P-G plug.**





**4 WATT,**

**all transistorized designed to operate 400 cycle servo motors with 26 volt control windings. Width—1.06 inches; Height 2.68 inches; Length—5.43 inches . . . Weight 7.1 ounces, Input Impedance 20K ohms, Gain 1000, Power Supply 28 VDC.**



*Our servo engineers are ready to help you. Let us have your requirements.*

**DAYSTROM INSTRUMENT**

*Division of Daystrom Inc.*

Archbald, Pennsylvania

# GM Seeks 'Fluidity' in $60 Million Engine

By Robert H. Cushman

**Indianapolis**—Allison's new $60 million jet engine development laboratory represents one of the largest self-financed bids ever made by private industry in an attempt to remain a prime contractor in defense business.

Allison Division, General Motors, now believes it has in its Plant 8 the greater part of the facilities needed to be competitive in gas turbine aircraft propulsion, but it has slowed down or delayed the completion of the original $75 million program announced by GM President Harlow Curtice early in 1955. The cutback has been to maintain the fluidity which Allison believes necessary to tailor itself to the new interests and economy program of the Defense Department.

### Turbo-Rocket Study

A step in this direction is the Aerojet-General, Allison turbo-rocket engine study. Turbo-rockets are a form of ducted rocket which combine the low fuel consumption and takeoff efficiency of a turbojet with the high altitude capability of a rocket.

Allison has also been mentioned as the logical division for General Motors to place any development work which may result from GM's current proposal for a gas turbine powerplant for the advanced version of the Maritime Administration-Atomic Energy Commission nuclear powered merchant ship (Public Law 848). The GM proposal comprises a closed-helium-cycle turbine drawing heat from a graphite-moderated, gas-cooled reactor.

Goal of the 4,000-employe Plant 8 complex which is now more than half completed and in partial operation is new business for the other manufacturing plants of the Allison Division.

Allison is now manufacturing the 10,000 lb. thrust J71 turbojet for the Navy F3H-2N Demon and the USAF Douglas B-66, the T56 turboprop used in the Lockheed C-130 Hercules, and some of the older J33s for the Lockheed T-33 trainers and the Martin TM-61A Matador and the Chance Vought Regulus I missiles. Production of the 501, commercial version of the T56, for the Lockheed Electra airliner is scheduled to begin.

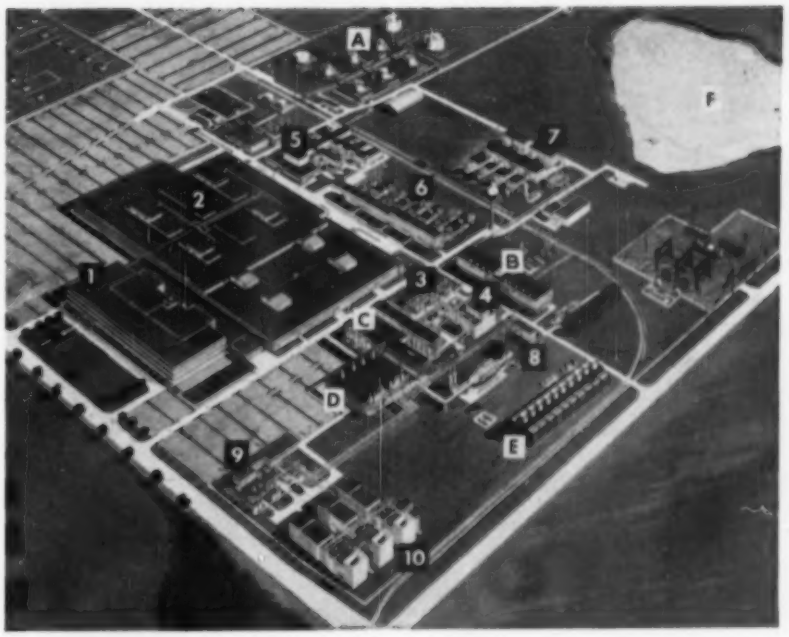
Ahead is the need for new designs which can be sold to the military services and commercial airlines when these engines and the 550 turboprop and 25,000 lb. dry thrust J89 now in development are obsolete.

### Plant 8 Rundown

Plant 8 is completely self-contained. It manufactures no product in the usual sense outside of the handful of development engines which are a by-product of an engine development program. It is a planned community in being solely to accelerate ideas into high performance hardware.

**ALLISON** specialists such as this engineer doing blade vibration study provide the "support in depth" which backs up designers.

**DURING** engine development at Allison's new center (facing page), parts of the engine designed in the engineering offices (1) (right) are built in the model shop (2) and tested in the combustor (3), compressor and turbine (4) and fuel control (5) test facilities. Complete engines are tested in the static cells (6), the forward flight ram cells (7) and altitude simulation cell (8). Dynamometer cells (9) and large propeller cells (10) are for turboprop development. For tests, fuel comes from farm (A), simulation airflow from electrical compressors (B) and gas turbine compressors (C) while altitude conditions are provided by exhauster (D). Cooling towers (E) recirculate water from pit (F) to lower exhaust temperature. Comparing facilities in existence (see facing photo) with facilities in sketch it will be seen that Allison has completed or started all but the altitude cell (8) and exhauster plant (D).




# R&D Facility

Outstanding features of Plant 8 are:

- **Central air pumping** units which can be combined to supply an impressive 600 lbs./sec., 90 psia. airflow to the separate test facilities.
- **Engine components** laboratories in which the air supply is directed at isolated portions of the engine to simulate operation in the engine.
- **Model shops** which are more elaborate and complete than many manufacturing shops.
- **Large turboprop** test cells capable of handling 15,000 hp. turboprops swinging 21 ft. diameter propellers and simulating flight speeds up to Mach 1.0.
- **Extensive, pleasant** engineering and administration offices, in the modern main office building.

## Air Pumping Plants

Of all these, the two air pumping plants stand out most to a visitor, both because of their large capacity and because they represent the heart of a modern development facility for air breathing engines.

Just completed, they are of two types. A low pressure gas turbine driven supply which feeds the compressor and turbine development laboratories and a high pressure electrically driven supply for the combustion development facility.

In the former, gas turbines with a total of 96,000 hp. can supply 480 lb./sec. of airflow. The 42,000 hp. electrically driven supply is expected to supply 120 lb./sec. at 285 psia.

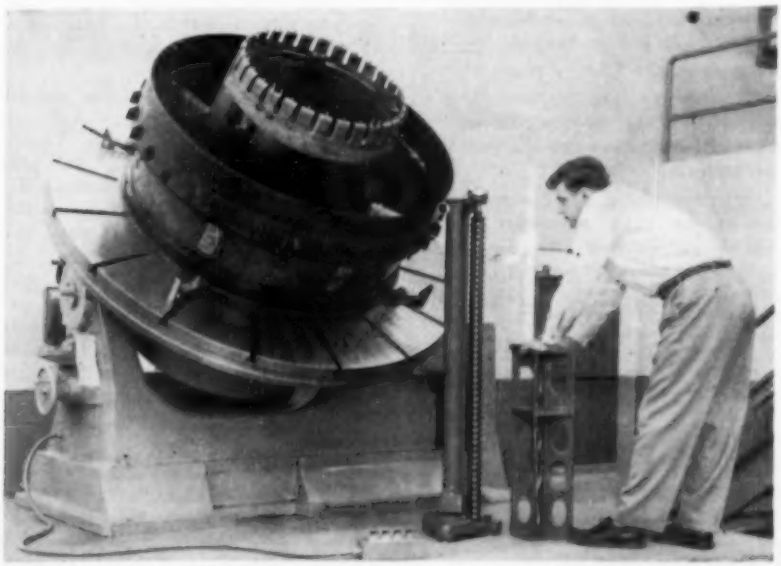
The low pressure gas turbine supply is the more remarkable because Allison has used parts of its own engines rather than the usual industrial equipment. The main low pressure air supply is made up of sixteen modified T56 compressors (only 12 of the 14 stages are used). Each modified compressor is driven by two complete T56 shaft turbines.

## Electrical System

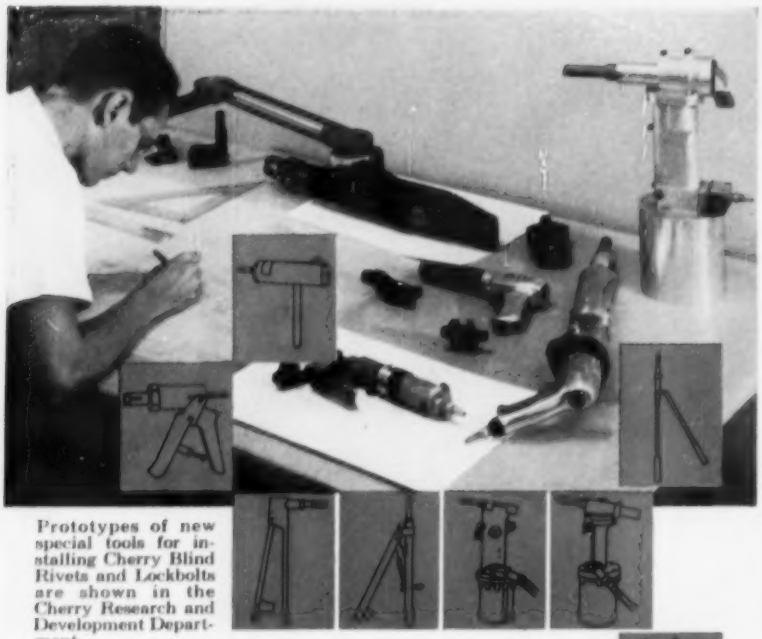
The electrical air supply consists of conventional industrial equipment where synchronous motors drive centrifugal compressors.

Supplementing the air supply are air exhausters made up from T56 combustion section-turbine combinations driving double-sided centrifugal compressors from a J33 engine. Air is exhausted from the component test facilities to simulate altitude conditions.

According to Allison, the advantages of using its own gas turbine components in this way are that original investment was lower and an air supply is available which produces usable air in five minutes after turbine light-off and can be shut down merely by turning the fuel valve off. A steam-powered electrical generating plant on the other hand would have required 24 hours advance notice before a test and then,



**TURBINE** casing for J89 turbojet being checked for dimensional accuracy in model shop. Barely visible is the annular entrance where airflow which has been by-passed around high pressure compressor for up to Mach 2.8 flight re-joins the mainflow.



Prototypes of new special tools for installing Cherry Blind Rivets and Lockbolts are shown in the Cherry Research and Development Department.

# Special Tools

## for building tomorrow's aircraft being developed today by Cherry research

Higher speeds and operating temperatures of aircraft, missiles and rockets of the future demand fasteners with greater resistance to the stresses imposed upon them than ever before.

Installation of these high strength Cherry Rivets and Lockbolts* will require new special tools such as those now in the development stage in the Cherry Research and Development Department.

This activity—anticipating the needs of the aircraft industry and the military—is an old story with Cherry. For years, Cherry engineers and technicians have devoted themselves to a single objective—the production of better aircraft fasteners and the tools for installing them.

Tools for solving specific problems—tools for efficient production fastening—all are developed and produced in the Cherry plant at Santa Ana which is devoted exclusively to the production of fastening equipment for the aircraft industry.

For information on the most efficient fastening methods for your operation—write Townsend Company, Cherry Rivet Division, P. O. Box 2157-N, Santa Ana, California.

*Licensed under Huck patents RE 22,792, 2,114,493, 2,527,307, 2,531,048, 2,531,049 and 2,754,703

**CHERRY RIVET DIVISION**

SANTA ANA, CALIFORNIA

**Townsend Company**

ESTABLISHED 1818 • NEW BRIGHTON, PA.

if the test were aborted for any reason, the remaining steam would have to be thrown away.

In organization, the talent of Plant 8 is divided into six main groups:

- **Advanced design** and development which guides the investigation of new engines and in conjunction with the Allison sales department tries to interest the military in these new engines.
- **Turbojet department** which takes the project responsibility for new turbojet engines after they have been sold.
- **Power turbine group** which takes similar project responsibility for new turboprops.
- **Turbine components** which takes care of engine details.
- **Experimental facilities** and testing which maintains and operates the test installations.
- **Production engineering** which has its executive engineer located in the Plant 8 office but is more concerned with production at the other manufacturing plants.

### Use of Plant 8

To illustrate how Allison might use these facilities, the development cycle of a turbojet will be traced through Plant 8. The turbojet might be considered a full Mach 3.0 successor to Allison's 25,000 lb. dry thrust J89 engine which has a weight flow of nearly 400 lb./sec. The new engine could be a refinement of the Allison 640 turbojet, a single spool powerplant which lost the WS110A powerplant competition to General Electric Co.'s Gas Turbine Department, or it could be a result of the present joint Allison-Aerojet General study of turbo-rocket hybrids.

A new design germinates in the preliminary design section of Charles McDowell's 250-man Advanced Engine Design Group.

The 50-60 man preliminary design section lead by veteran engine designers as McDowell's assistant, Jack B. Wheatley, is continually studying the propulsion spectrum. In close liason with Allison sales engineers who alert the section to Pentagon interests, these engineers will take military propulsion requirements (which most likely will be stated in a request for bids in design competition) and draw upon their experience to consider first all possible ways the job might be done and then which system should be selected.

The dogwork of the selection would be speeded by programming the parameters on one of Allison's IBM digital computers and then running each type through. Allison is equipped with IBM 705, 704 and 650 computers. The resulting selection would be crystalized in an Allison proposal submitted in the military design competition. Because the stakes are very high, per-

haps $50-150 million in business involved, a great deal of intensive work goes into this phase.

These engineers do not have to create out of a vacuum. The special virtue of a modern developmental complex like Plant 8 is that it provides an environment conducive to creative engineering. In conjunction with GM's Technical Center in Detroit, Plant 8 provides a "community of knowledge" in which all specialized research sections like metallurgy, aero-thermodynamics and mechanical design are available as consultants to the preliminary designers. Allison calls this "support in depth."

### Dynamic Operation

Basic ingredient of Plant 8's operation is that it provides the means to start and maintain the series of closed loops which are the essence of the modern engineering method.

For example, if the design group fears that one feature of its paper engine will make or break the proposal, the group can isolate this feature and put it through a development "loop."

Assuming the group is worried about the airfoil shape of a compressor blade, a representative blade can be sent to the model shop for fabrication into a test specimen. The blade development wind-tunnel facility subjects this blade to simulated operating environment and records its performance. The test analysis group reduces the record of the test specimen's performance and feeds the digested information back to the design section, thus closing the information loop.

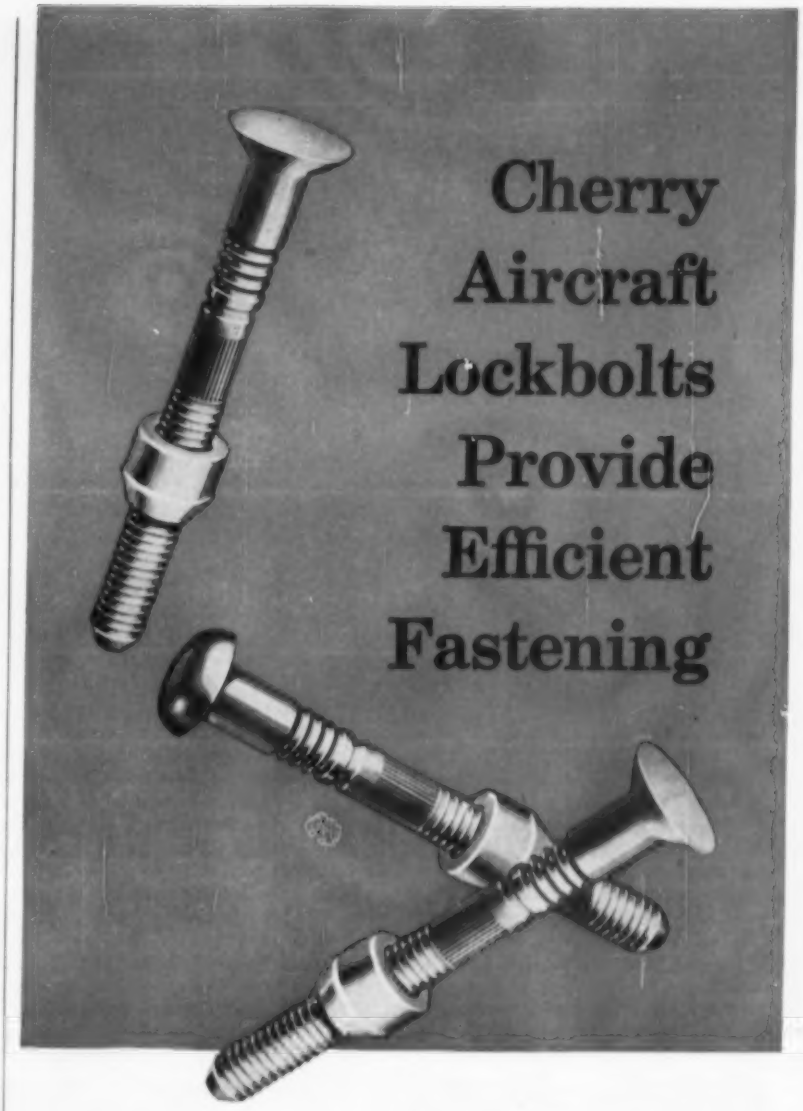
What the preliminary design section learns from the feed-back either stimulates it to refine further its concepts and start another loop or gives it the confidence to gamble on its selection. According to Wheatley, the preliminary design section might go as far in this direction as to test a complete engine compressor or turbine stage.

### Design Process

In the overall development process of an engine these closed loops are end-to-end in a continuous process which may be likened to a converging spiral which zeros in on the final optimized configuration. The crux of modern research and development progress is the rapidity and deftness with which a development organization can circuit these loops and accurately close in on the best possible final product.

Payoff of GM's investment in Plant 8 would be the increase in speed with which Allison engineers can turn out successful new engines.

The advanced engine development Group may work on the overall design selection and proposal presentation to the military from a few months to any-


Cherry Aircraft Lockbolts* save weight—give higher clinch than rivets—more uniform clinch than nuts and bolts—combine advantages of both—eliminate disadvantages.

Cherry Aircraft Lockbolts are designed and produced to meet specifications and requirements of the aircraft industry.

Cherry Aircraft Lockbolts are available from complete stocks in a wide range of diameters, grip lengths and head styles in alloy steel and aluminum alloy.

For data on Cherry Lockbolts, write for bulletin TCL-111 to Townsend Company, Cherry Rivet Division, P. O. Box 2157-N, Santa Ana, Calif.

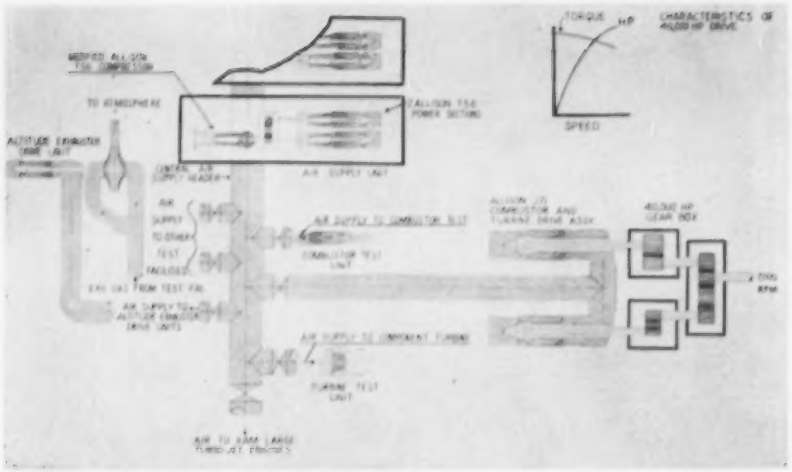
*Licensed under Hack patents RE 22,792, 2,114,493, 2,527,307, 2,531,048, 2,531,049 and 2,754,703

**CHERRY RIVET DIVISION**

SANTA ANA, CALIFORNIA

**Townsend Company**

ESTABLISHED 1816 • NEW BRIGHTON, PA.



**SCHEMATIC** of Plant 8 air supply shows how Allison has used parts "pirated" from their older engines to supply the air for the development of new engines.

where to up to a couple of years. Once an engine wins a military design competition and receives a development contract, the engine is taken from the advanced design section and given to the turbojet design group where it becomes a formal project.

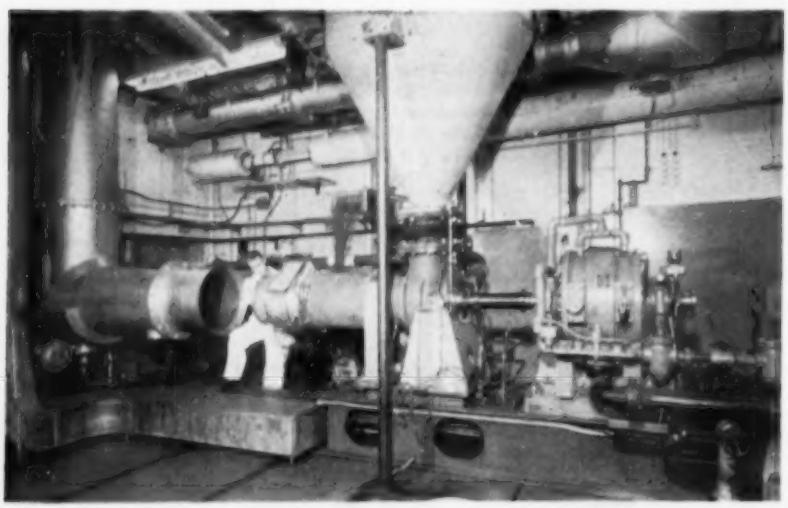
### Project's Job

The engine project's job is to use all the facilities at it's command at Plant 8 to develop the basic design into a manufacturable item which lives up to the performance guarantees made by the advanced engine design group.

By breaking down the functions of the engine into component parts the whole Plant 8 can be phased into simultaneous contribution to the overall development program.

The development of a light weight, efficient compressor is perhaps the most typical portion of a turbojet engine program. At Allison, the hardware development of the compressor might start with epoxy plastic wind tunnel models of blades being molded in the new Plant 8 plastics tooling shop. Allison says that the plastics shop can produce test blades accurate to .003 in. of contour and then can easily use the the method to provide duplicate blades for cascade testing.

The first facility used in the compressor development program would be the small 10 lb./sec. cold flow wind tunnel in which these plastic blade shapes up to 5 in. in height would be tested. After individual blade airfoils have been developed, rows of



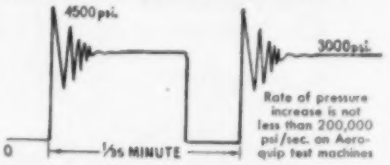
**TURBINE** component facility is typical of test rigs which perfect main parts of the engine in isolation. Air coming in from left is directed at the turbine, (center) and exhausted upwards in a diffusing section. Power developed by the test turbine is absorbed and recorded by the dynamometer (right).


# Aeroquip
## Engineering Notes

B. A. MAIN, JR.

The advertisement at the right reveals a new construction for high pressure hose of Teflon. Naturally there is a reason for going to this type of construction and I'll try to show here why we did it.

The most widely used measuring stick for evaluating high pressure hose is the impulse test. In this test, the hose line is subjected to hydraulic impulse pressure varying from 0 pressure to 3000 psi., with a surge peak pressure which reaches 4500 psi. The pressure curve shape is shown below:




A hose line is considered adequate if it will withstand 100,000 cycles or applications of this pressure curve, and in the case of hose of Teflon, the fluid in the hose and the ambient air surrounding it must be held at 400° F.

We began this development by building and testing hoses using conventional two-wire braided reinforcement around the inner tube of Teflon. In the -4 size, two wire braids proved to be adequate reinforcement to withstand the impulse test, each time samples were tested.

In the -6 size, we tested many constructions of two-wire braided hose of Teflon. We explored both 302 and 304 stainless steel wire in sizes from .011" to .015" diameter. We also explored the use of carbon steel wire for the inner braid using various wire sizes. Twelve separate impulse tests involving hundreds of samples were necessary to investigate all combinations; in every case one or more samples failed before completing the 100,000 cycles of impulse. Our experience with the -8 size paralleled that with the -6 size.

The failures always begin with the inner braid. Here, individual wires break at the crossovers which are formed when wires are first brought over and then under other wires in braiding. As soon as a sufficient number of the individual wires break, the hose bursts during the test.

The obvious solution to this problem was to eliminate the crossovers of braiding by substituting the two spiral wire wraps for the inner braid. This required new machinery and techniques, but we now produce the hose successfully.

We have now finished six separate impulse tests successfully on the -6 and -8 sizes. The samples tested have included both carbon steel wire and stainless steel wire for the spiral wraps and both wires passed the 100,000 cycles every time.

Work on this project has convinced me that it is impossible to build a braided hose size -6 and larger which will withstand this impulse test every time the hose might be subjected to the test.

In our tests of the -6 size we did have two successful tests of braided hose, but when these were retested the samples failed, so you can't judge by one test alone.

The spiral construction provides the best high pressure hose available today. It can be used at the same bend radii as equivalent two-wire braided hose, and compares nearly exactly in weight and size.

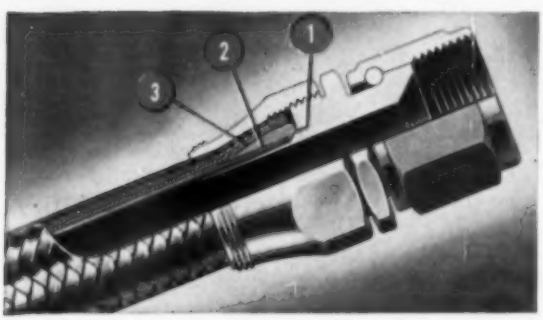
B. A. Main Jr.

VICE PRESIDENT, ENGINEERING
AEROQUIP CORPORATION

SPIRAL WRAP
adds lasting strength
Stainless steel wire is closely wrapped at a precise angle to form a smooth reinforcement layer. This prevents brinelling of the tube, eliminates wire stress concentration common in braided reinforcement and provides optimum strength and flexibility. Outer cover is stainless steel wire braid. Tube of Teflon is distinctive Aeroquip red.

# Specify Aeroquip 677 Hose of TEFLON* and Reusable "*super gem*" Fittings for 3000 psi. Systems

**GET ALL THESE IMPORTANT ADVANTAGES:**




*Leakproof, too!* This cutaway view shows how Aeroquip "*super gem*" Fittings protect against leakage at all pressures: **(1)** a metal-to-metal line seal; **(2)** a lip seal formed by the tube of Teflon seated, but not compressed, between the nipple and sleeve. Compression of wire reinforcement **(3)** assures positive grip and lasting protection against fitting blow-off.

*Hose Strength that lasts and lasts!* The secret is in the hose construction perfected by Aeroquip . . . multiple spiral wrap reinforcement that resists impulse fatigue and prolongs the life of the hose line.

*Reusable "super gem" Fittings that cut costs!* Fittings are often the most expensive part of a hose line, well worth saving when engineering or production changes call for fluid line alterations. With "*super gem*" Fittings you save ALL, not part, of the fittings. Hose line assembly and disassembly is quick and easy, using ordinary bench tools.

*High performance, high temperature hose lines of Teflon* especially designed for 3000 psi. aircraft systems by the leading producer of hose lines for aircraft applications. Mail the coupon below for complete information.

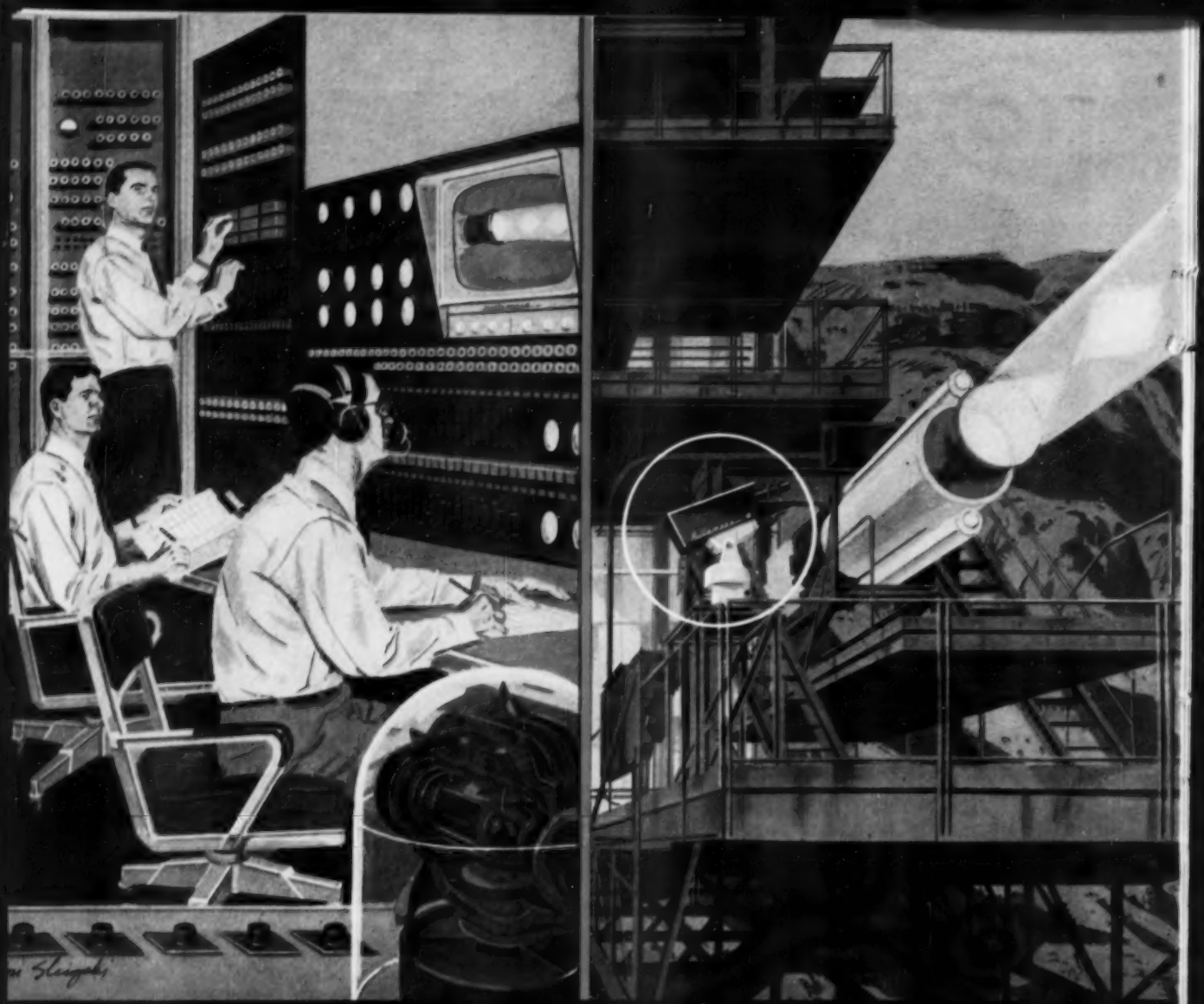
**Aeroquip Corporation, Jackson, Michigan**
**Western Division, Burbank, California**
**Aeroquip (Canada) Ltd., Toronto 10, Ontario**

Aeroquip
REG. TRADEMARK

*DuPont trade name for its tetrafluoroethylene resin.
"*super gem*" is an Aeroquip Trademark.

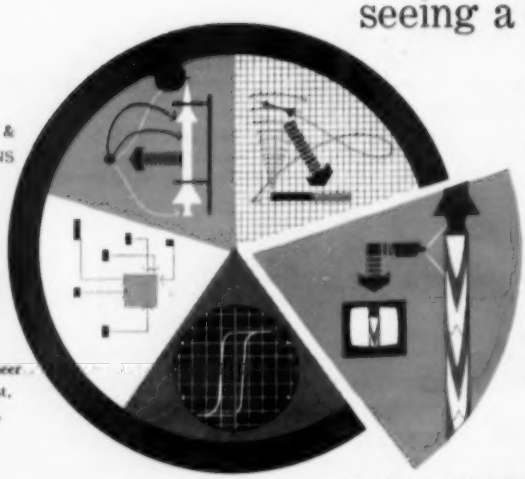
Aeroquip Corporation, Jackson, Michigan
Gentlemen:
Please send me engineering bulletin AEB-16 with complete information on Aeroquip 677 Hose of Teflon and "*super gem*" Fittings.

AW-10
Name
Title
Company
Address
City Zone State



# seeing a hot one...on Hallamore captive TV

ENGINEERS & TECHNICIANS
For ideal working conditions with a dynamic, creative organization, send resume to Chief Engineer, 8352 Brookhurst, Anaheim, Calif.



Far too hot, and positively too ear-splitting, for close, on-the-spot observation by human beings...when high thrust propulsion units are fired up for test, Hallamore closed-circuit television takes over the job. Throughout industry, similar Hallamore systems are finding application...wherever the requirement is for remote observation or for fast transmission of visual impressions. Hallamore Electronics designs, develops and manufactures missile ground support and in-flight instrumentation systems, magnetic products, electronic components and audio visual communications systems. Current activity includes contracts for the United States armed forces and prime contractors of the aircraft and ordnance industries.

79-57

HALLAMORE ELECTRONICS COMPANY

*a division of the SIEGLER CORPORATION*

blades would be tested in cascade.

Development grows progressively into tests of complete rotating stages. In this, Allison's compressor and turbine airfoil facility would be used. A 12,500 rpm., 3,500 hp. motor in a 100 lb./sec. airflow is used in the rotating compressor and turbine wind tunnel. (Until such time as this facility is completed GM's cascade wind tunnel at Detroit would be utilized.)

The ultimate in compressor testing is the component compressor laboratory in which a complete compressor assembly is driven by two modified Allison J71 burner-turbine combinations, with air for both test and driving turbines supplied by the plant air supply.

### J71 Turbines

The two J71 turbines supply 36,000-40,000 hp. to drive the compressor for a J89 or larger size engine. This incidentally indicates how much of the output of a turbojet is "locked up" in the compressor-turbine assembly just to complete the operating cycle.

For simulation of high speed flights, 340 lb./sec. airflow can be pumped from the plant supply and rammed into the test compressor. The inlet air can also be delivered at various temperatures and pressured to simulate nearly the full range of altitude effects. By adjusting temperatures and pressures to alter the "corrected airflow" the 400 lb./sec. J89 compressor was developed in these facilities.

The turbine is likewise developed through individual blading, cascade, individual stages and up to complete full scale operating level.

But instead of being driven by a shaft, it is driven by the plant air supply and the resultant shaft output absorbed by a 25,000 hp. dynamometer. It should be noted that since cold air is running the turbine in this simulation, it will not produce enough horsepower to match that needed to drive the component compressor in its test.

### Combustor Test

Unlike the compressor and turbine component test facilities, the Plant 8 combustor facilities are incapable of testing the full combustor of a large engine. Instead either individual combustor cans in a cannular engine as the J89 or pie-shaped slices of a full annular combustor, which would amount to ⅛ to ¼ of the complete combustor, are tested.

The maximum conditions which can be simulated at the combustor entrance are 120 lb./sec. airflow at 1,000F and 285 psia. The latter figure would indicate that Allison contemplates compression ratios up to nearly 20:1. Fuel flows to the combustor are up to 8,000 lb./hr. at up to 600 psia.

The test values which instrumentation measures in the separate facilities are automatically collected and wired into Central Data Recording's bank of IBM digital computers which are programmed so that they rapidly collect the myriad bits of information, put them in equations, automatically solve these equations, and present the results to the design engineers in as useful a form as possible. The more directly a test result can tell the engineer which way to alter the design geometry for better performance, the better.

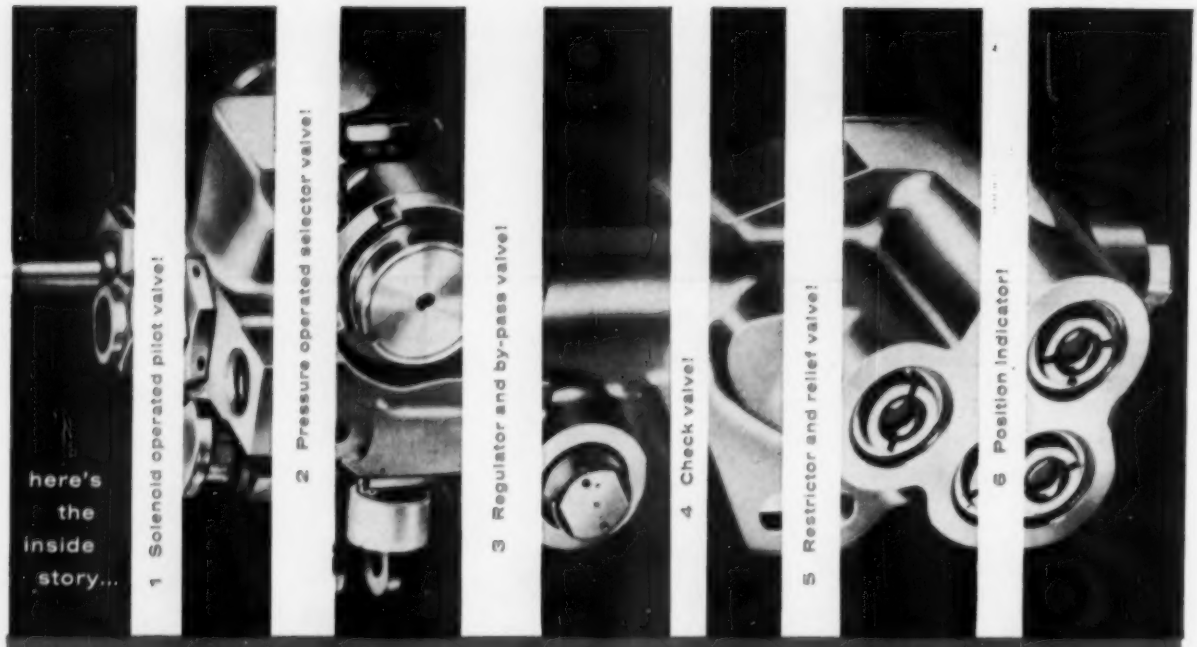
The fuel systems laboratory is a 53,000 sq. ft. facility (80% complete) which can safely test fuel controls for Mach 3.0 aircraft in 650F, 80,000 ft. environments.

In the early stages of an engine's development, the servomechanisms experts in the engine fuel control design section use the Berkeley analog computers to rough out the characteristics for the individual components in the fuel control.

### Component Phasing

Further along, the actual components will be progressively substituted into the analog set up. First components, then the complete fuel system will be installed in the temperature and altitude tanks to see if the dy-

Research, Engineering and Development Services on Precision Mechanical Devices for aircraft and general industries. New fully equipped experimental machine shop and engineering test and development laboratory for HARTWELL'S engineering staff are "AT YOUR SERVICE!"
HARTWELL TEAMWORK
Over two decades of successful problem-solving experience in the fields of Flush Latches & Hinges; Fittings; Cable Terminals; Float Valves & Assemblies. HARTWELL'S highly developed skills and production abilities are "AT YOUR SERVICE!"
If you have a problem in one of our fields, or are beginning designs, HARTWELL TEAMWORK is "AT YOUR SERVICE!"
REQUEST NEW BROCHURE DESCRIBING OUR FACILITIES
HARTWELL AVIATION SUPPLY COMPANY
9035 Venice Blvd., Los Angeles 34, California
BRANCH OFFICES: Hackensack, New Jersey
Wichita, Kansas • Fort Worth, Texas • Seattle, Washington




# the new dimension in component packaging!

## Weston's Pneumatic Actuator Control Valve Package Combines 6 Components in a Single 6.4 lb. Unit!

While controlling the pneumatic actuator, this weight and space saving valve also provides for snubbing pressure at the opposite end of the stroke. It affords extremely fast operation (maximum at .04 seconds) and low leakage (10 cubic inches per hour). The selector valve is non-interflow and detented to maintain position. If you have a weight and space problem, let Weston's team of specialized package engineers solve your specific application.

weston BW a subsidiary of Borg-Warner Corporation

**HYDRAULICS LIMITED** 10918 Burbank Blvd., North Hollywood, Calif. Dept. AW-10

Export Sales: Borg-Warner International 36 South Wabash Ave., Chicago 3, Illinois
Eastern Representative: Mr. W. R. Beckerle 14 South Boro Lane, Glen Rock, New Jersey Telephone: Gilbert 4-2094
Midwest Representative: Mr. E. A. Polowniak 11767 Fawnridge Drive, Kirkwood, Missouri Telephone: YOrktown 6-4861

namic performance deteriorates. Plant 8 fuels laboratory has simulation benches which take flows up to 130 gpm. and 1,500 psig.

### Complete Engine Test

After perhaps two years of preliminary design and component work and, overlapping the latter, portions of the full scale component work, the first entire engine is built by the Plant 8 model shop. Though all design refinements may not yet be assimilated from the component tests, the first complete engine is brought along so that drafting-level designers and the model shop workmen may familiarize themselves with the mechanical and manufacturing aspects of the engine. Actually without overlapping development programs it would be impossible to squeeze all of the skills of Plant 8 into a five year engine development program.

First the emphasis is on smooth mechanical operation. It is even likely that the engine will be pre-assembled bald (without blading for compressor and turbine) and motored to check clearances and lubrication.

Plant 8 has a row of 8 static test cells to build operating experience with new engines. New engines often take 2,000 or more hours of static cell running before they are de-bugged sufficiently to pass the official USAF 50 hour flight qualification test.

Plant 8's interchange of knowledge continues all through the development program. As the static test shows up defects (the engines are continually torn down and examined after the runs) troubleshooters are alerted in the various specialized branches of Plant 8. For example if a combustion liner keeps developing cracks after so many hours of running, the combustion development laboratory may drop some of its work and concentrate in a redesign which will permit the engine to pass the 50 hour test.

Once the 50-hour test milestone has been passed, the emphasis is switched from endurance to performance. The more subtle problems such as blade vibrations, uneven temperature distributions across the turbine nozzles, compressor surge on very rapid accelerations, flow leakage past seals and a host of others are spread out over the breadth of the departments. One by one these are "licked," perhaps by going back to component tests where the problems can again be examined in isolation.

### Flight Simulation

Though Allison has a flight test hangar at nearby Weir Cook Municipal Airport, the chances are that unless the airframe for which the new engine has been scheduled is ready at USAF's Edwards AFB flight test center, there will be no flying test bed capable of taking the new engine up to its full perform-

## Army Gets First Cessna YH-41

First of an evaluation quantity of Cessna YH-41 Snecma four-place helicopters leaves Wichita, Kans., for Edwards AFB, Calif., where it will be sent to U. S. Army's Ft. Rucker, Ala., installation for trials by the Aviation Board, Transportation Supply and Maintenance Command and Aviation School. Powered by a 270 hp. Continental FSO526A, Snecma grosses 3,000 lb., has a useful load of 950 lb. Cruise speed is over 100 mph., endurance is 3.9 hr.


Air Force Infrared measuring program chooses Barnes instruments

*University of Michigan scientists using Barnes Far Infrared Mobile Laboratory on Pikes Peak.*

The majority of participating groups in the Air Force's critical pioneering study on infrared radiation of background and targets selected Barnes infrared measuring equipment.

This equipment included Infrared Radiometers, OptiTherm® Far Infrared Cameras and low and high temperature Infrared Reference Sources. Barnes Engineering is the only commercial source for completely integrated radiation detecting and measuring instruments of this kind.

The standard line of proven field and laboratory infrared equipment offered by Barnes includes:

- Infrared Radiation Measuring Equipment
- Infrared Radiation Sources
- Thermistor Infrared Detectors
- Building Blocks for Infrared Systems

Advances in radiation detection and remote temperature measurement owe much to developments that originated with the Infrared Division at Barnes Engineering. They are equipped and staffed to develop your infrared systems.

*If you are thinking of using infrared, write for complete information on the integrated line of Barnes OptiTherm infrared radiometers, sources, detectors and components.*

BARNES ENGINEERING COMPANY
Stamford, Connecticut

*Are you on the mailing list for TECHNIQUES? This publication, devoted to developments in infrared detection, will be sent on request.*

# Westinghouse proves performance of new J54 Turbojet

The J54 . . . designed by Westinghouse as an investment in the defense of America . . . has passed a major developmental milestone.

Less than 30 months after design conception, the J54-WE-2 has:

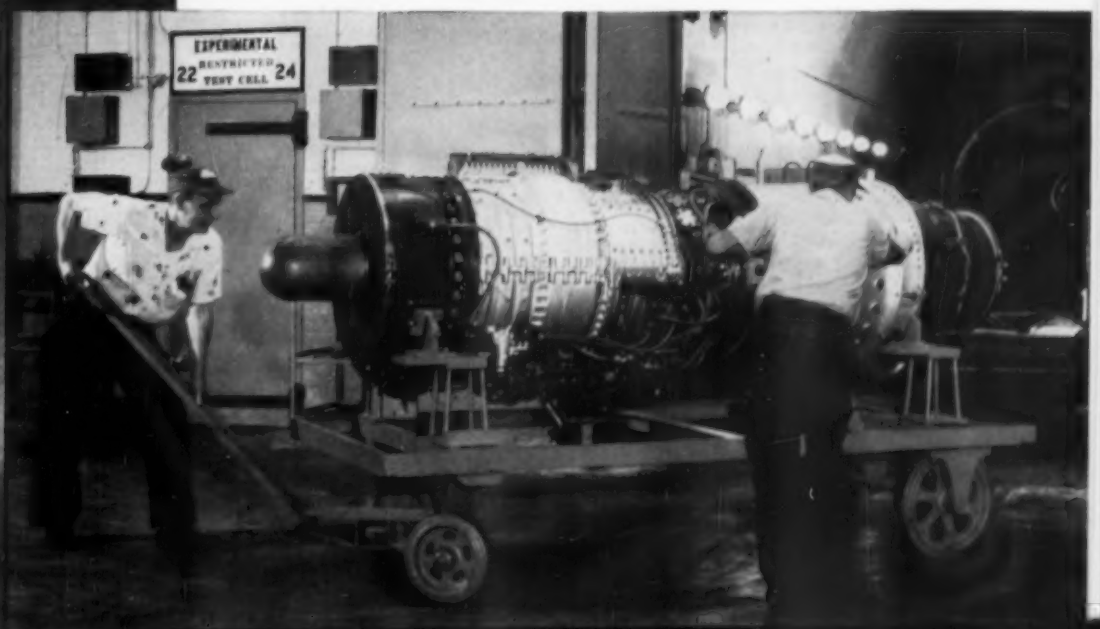
- performed successfully . . . a 150-hour endurance test
- performed successfully . . . flight tests to altitudes limited only by the service ceiling of the test bed
- performed successfully . . . simulated flights, higher than any reached by operational turbojet aircraft, in an altitude chamber at the U. S. Naval Air Turbine Test Center

This medium thrust class, lightweight, single-spool turbojet has been designed for economical manufacture and operation. Continuing studies of advanced J54 configurations give promise of further satisfactory performance in many applications.

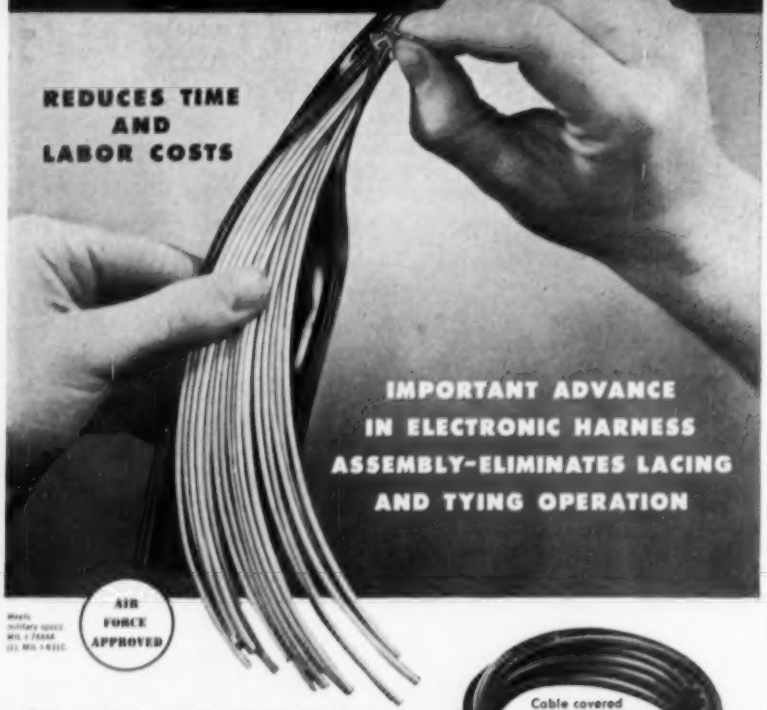
Successful performance in this Westinghouse-financed J54 program typifies Aviation Gas Turbine Division capability. For J54 application data in convenient TAPE form, or general information on Westinghouse capacity, call your Westinghouse Defense Products salesman or write: Westinghouse Electric Corporation, Aviation Gas Turbine Division, P.O. Box 288, Kansas City, Missouri. J-54043

YOU CAN BE SURE...IF IT'S

Westinghouse



# Zippertubing




AIR FORCE APPROVED

This revolutionary new zipper-style plastic tubing, "Zippertubing," is used to enclose, protect and identify multi-conductor wiring in the aircraft, electronic or electrical industries. The extreme simplicity and ease with which wiring can be encased will reduce the normal time spent on wire harnessing and cable covering by as much as 90%. With Zippertubing, a secure jacket can be applied in seconds and prevents abrasive wear on expensive custom cabling, or used as a substitute for lacing and tying, as wiring ducts, for wire marking, etc. When Zippertubing is used, the need for dilating conventional tubing is eliminated.

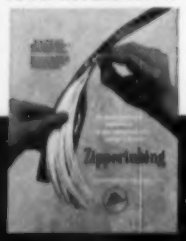
Zippertubing is flexible, provides accessibility to work points, and offers ease of application. Zippertubing is available in nine colors, including black and clear plastic, and can be obtained in continuous lengths from 20 to 300 feet. When closed, it will withstand a linear strength test of 45 lbs. per inch and is available from ½" to 4" I.D.'s. Additional strength available if required.

Write today to find out how Zippertubing will reduce your time and labor costs. CALL THE DISTRIBUTOR OR REPRESENTATIVE IN YOUR AREA. HE WILL BE HAPPY TO DISCUSS YOUR APPLICATION.

Short length used as cable marker—closed manually or sealed.

**Zippertubing** Cross Section of Standard Configuration for General Purpose Use.

**Zippertubing** Cross Section of Military Configurations, Air Force Approved Construction.




*The broad applications, specifications and versatility of Zippertubing are completely described in this bulletin available to you. Write for it today.*

THE Zippertubing CO.

Patented & Patents Applied For

Division of Walter A. Plummer Co.

**Sales Office:** 5333 So. Sepulveda Blvd.—Culver City, California


ance. Even if there were it has been found that it is far more expeditious to simulate the high performance altitude conditions, if possible, on the ground.

Allison had originally planned for both altitude and speed simulation test cells to be completed by 1959. However, because of the present lack of government interest in large air breathing powerplants, Allison has decided to slow down on the work on its flight ram cell and to hold the altitude cell (which one source pegged at $15 million) in abeyance.

### Ready for Mach 3

Even so, since Plant 8 now has the necessary air supply, Allison could have both these facilities completed by the time any Mach 3.0 engine came along.

The turbojet high speed flight simulation facility now 30% complete will ram 500 lb./sec. air into the engine through a choked nozzle to simulate Mach 2.0-3.0 speeds. The engine inlet pressures under these conditions will be between 10-50 psia. and the temperature will go up to 600F. Thrust measuring capacity is planned to be 50,000 lb. with fuel flows 36,000 and 100,000 lb./hr. to the engine and afterburner respectively. Seven hundred and sixty data channels will lead to Central Data Recording.

The altitude simulation facilities, by far the most ambitious feature of the original plan, excluding the air supplies, was to have been of sufficient size to test a 295 lb./sec. airflow engine

## Suppressor Details

Corrugated silencer nozzle developed for the Rolls-Royce Avon 29 engines on the Comet 3 consist of six small triangular fairings inside tailpipe. Their area is distributed to take the place of the propelling nozzle at the end of the tailpipe. Cooling air from the free stream is pumped through external holes by the ejector action of the exhaust (AW Sept. 23, p. 52). Silencers were effective in evaluation.

# ENTER THIS CONTEST ...90 CASH PRIZES!

**CONTEST RULES**

1. Tell in 25 words or less "Why I prefer Albanene tracing paper."
2. Send all entries to K&E Albanene Contest, Box 160, New York 46, N. Y. Enter as often as you wish. There is nothing to buy.
3. Entries must be postmarked not later than midnight, Nov. 30, 1957.
4. Entries become the property of Keuffel & Esser Co. None can be returned.
5. The decision of the judges is final.
6. Winners will be notified by mail. A complete list of winners will be sent upon request, providing request is accompanied by stamped, self-addressed envelope.
7. Contest is open to all residents of continental United States, except employes, and their immediate families, of Keuffel & Esser Co. and its subsidiaries and dealers; its advertising agency; and judges of this contest.
8. Also not applicable to residents of those states where there are prohibitory laws.

## Why I prefer **ALBANENE**® Tracing Paper...

**First prize . . . . . $1500**
**Second prize . . . . . $1000**
**Third prize . . . . . $ 500**

**plus 87 prizes of $25 each!**

In 25 words or less, tell us why you prefer K&E Albanene® tracing paper. Your reasons may win one of these 90 prizes (it's K&E's 90th anniversary).

**Here's a hint:** Albanene is made from 100% rag stock for superlative tear strength. It is permanently transparentized with an inert resin. Draftsmen like it because of its easy drawing qualities . . . reproduction men for its high transparency and permanence. Everybody likes it because "what you pay for stays in the paper." That's why Albanene is the best seller among *all* tracing papers.

**Get contest aids** from your K&E dealer: Information booklets, extra contest entry blanks, samples of Albanene, too, if you need them. You can enter as often as you please.

Or use a plain sheet of paper if someone's already snipped the blank below. Give your name, address, and firm name, twenty-five words or less telling why you prefer Albanene tracing paper, and mail to K&E Albanene Contest, Box 160, New York 46, N. Y. before midnight, November 30, 1957.

**KEUFFEL & ESSER CO.**
New York, Hoboken, N. J., Detroit, Montreal, Chicago, St. Louis, Dallas, San Francisco, Los Angeles, Seattle.
Dealers in principal cities

**K & E Albanene Contest, Box 160, New York 46, N. Y.**

Here's why I prefer Albanene Tracing Papers_____

_____

_____

*Name*_____ *City*_____ *Zone*_____ *State*_____

*Street*_____ *Firm Name*_____

up to 66,000 ft. at Mach 1.0. The fact that despite its impressive magnitude it could go no further except of course, on smaller engines vividly illustrates why no private contractor can afford to duplicate the complete flight envelope simulating facilities supplied by NACA's Unitary Plan Mach 2.0 to 3.5 propulsion wind tunnel or the unsurpassed facilities of USAF's Arnold Engineering Development Center, Tullahoma, Tenn.

These government facilities would be used to complete the flight simulation at the end of the engine development program (AW Aug 6, 1956, p. 202).

### Complete Run

The climax of the ground program would be a run of the complete inlet-engine-exhaust propulsion package in conjunction with the airframe manufacturer in Tullahoma's gigantic 16 ft. square test section supersonic propulsion windtunnel. In this test, the propulsion system could be flown up to full Mach 3.0 and up to 100,000 ft. altitude with full simulation and even farther with partial simulation of flow conditions. In future engine contracts such runs may be used to verify the contractors performance of his contractual obligations, and possession of smaller in-plant simulation facilities are important in helping the contractor prepare a high performance propulsion system.

## Chinese Troops Use Helicopters

Evidence of increasing airborne capability of Chinese Communist forces is contained in these photographs of troops and weapon unloadings from Hound helicopters during maneuvers. Poor communications in China encourage air support. Hounds are USSR-built.

# ATLAS *Precisioneers*

## "HUSH-HUSH" ASSEMBLIES FOR

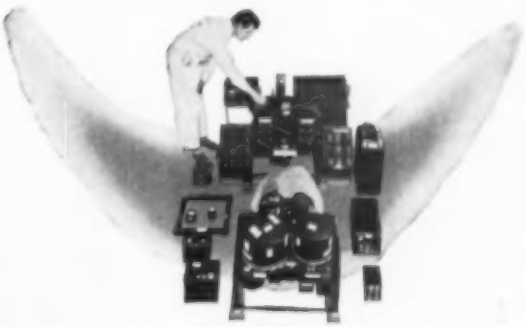
# THE FALCON

NO HIDING place "upstairs" for enemy bombers with The Falcon on the hunt. This newest guided missile is being produced for the U. S. Air Force by Hughes Aircraft Company.

Some of the "innards" of this bird of prey are ATLAS-Precisioneered and classified "confidential." But there's no secret as to how ATLAS can help you develop parts and assemblies from pilot stage to production efficiency for radar . . . sonar systems . . . computers . . . correctors . . . all types of electro-mechanical devices. Just bring your designs to ATLAS. At your disposal on a job basis are our men, equipment, techniques; facilities available for prototype, pilot run, and or volume production.

When war or peace demands a product, call on ATLAS Precision Products Co. (Div. of Prudential Industries), Philadelphia 24, Pa.

Send for booklet, "Precisioneering Electro-mechanical Equipment."



ENGINEERING • PRODUCTION • ASSEMBLY

SERVICE ATLAS DEPENDABILITY QUALITY

**ATLAS**
*Precision Products*

# AN INVITATION TO JOIN ORO

### *Pioneer In Operations Research*

Operations Research is a young science, earning recognition rapidly as a significant aid to decision-making. It employs the services of mathematicians, physicists, economists, engineers, political scientists, psychologists, and others working on teams to synthesize all phases of a problem.

At ORO, a civilian and non-governmental organization, you will become one of a team assigned to vital military problems in the area of tactics, strategy, logistics, weapons systems analysis and communications.

No other Operations Research organization has the broad experience of ORO. Founded in 1948 by Dr. Ellis A. Johnson, pioneer of U. S. Opsearch, ORO's research findings have influenced decision-making on the highest military levels.

Our computer laboratory is equipped with the 1103-A Univac, the "Cadillac" of computers. Encompassing 1200 sq. ft., it is leased at a cost of $40,000 per month. ORO's professional atmosphere encourages those with initiative and imagination to broaden their scientific capabilities. For example, staff members are taught to "program" their own material for the Univac computer so that they can use its services at any time they so desire.

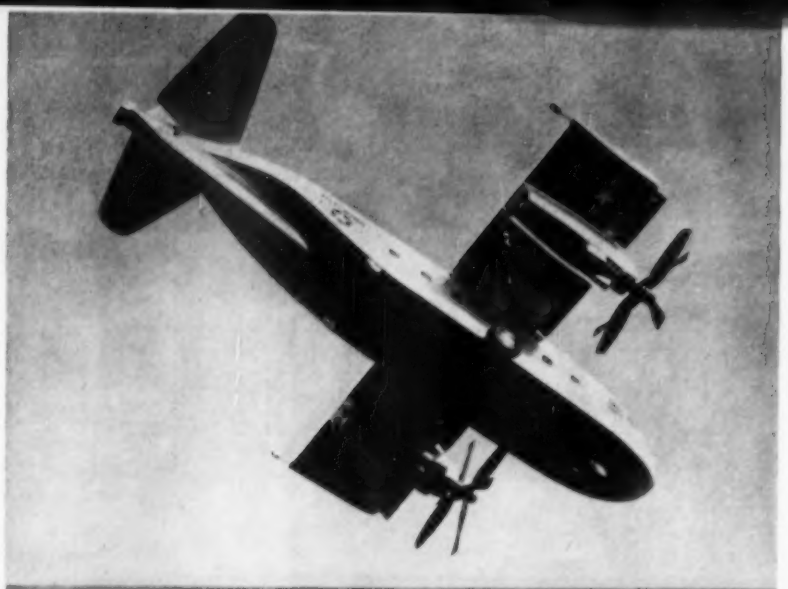
ORO starting salaries are competitive with those of industry and other private research organizations. Promotions are based solely on merit. The "fringe" benefits offered are ahead of those given by many companies.

The cultural and historical features which attract visitors to Washington, D. C. are but a short drive from the pleasant Chevy Chase suburb in which ORO is located. Attractive homes and apartments are within walking distance and readily available in all price ranges. Schools are excellent.

***For further information write:***
***Professional Appointments***

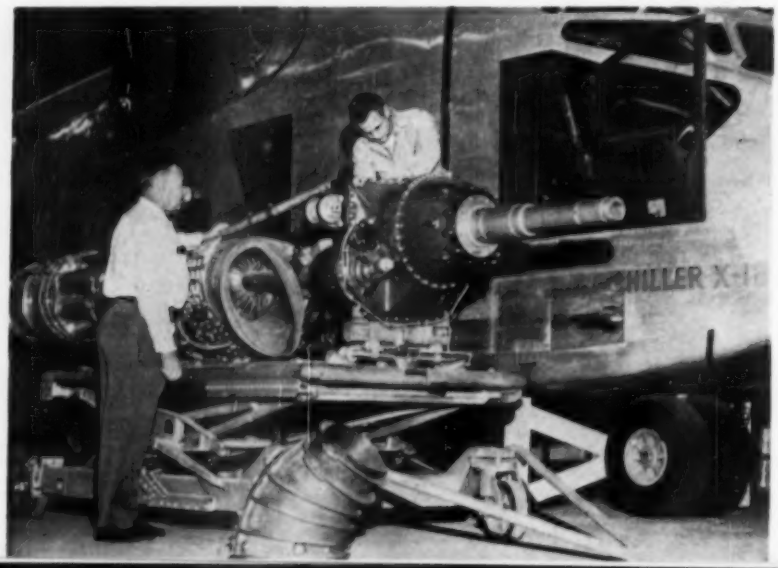
**OPERATIONS RESEARCH OFFICE** ORO

**The Johns Hopkins University**
7100 CONNECTICUT AVENUE
CHEVY CHASE, MARYLAND

## Hiller Assembles VTOL Transport

One of two 4,850 ehp. Allison YT40-A-14 turboprop engines for Hiller X-18 VTOL transport is shown below before installation in modified Chase transport. A model of the USAF-sponsored tilt-wing VTOL has completed tethered flight tests. Photo above shows how completed X-18 will look. Transport will have full-span leading edge slats; wingtips are fitted with small wheels on long struts to stabilize X-18 during landing and takeoff; contra-rotating propellers are fitted. Jet orifices at tail are to provide control during hovering and transition flight stages.

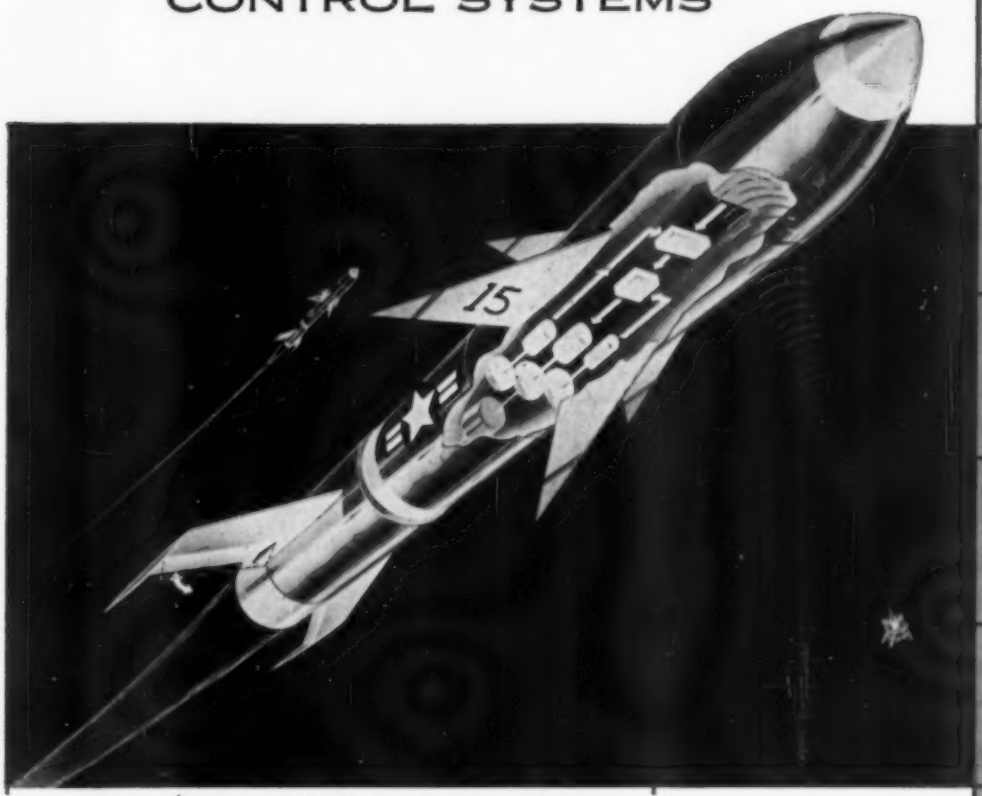


Simplify ordering and assure uniformly high quality of performance, with the advantage of Norden-Ketay's nationwide field engineering service. The following 6 pages describe modular units in Norden-Ketay's family of control components. You may use the coupon below to request literature on any units.

# NORDEN-KETAY

# CONTROL COMPONENTS

## SIMPLIFY AUTOMATIC CONTROL SYSTEMS



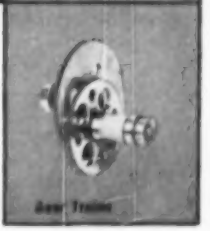
Digital Comparators

Amplifiers

Tachometers

Servo Motors

Digital Converters


Gear Trains

Check numbers of bulletins desired.

☐ 418 ☐ 423
☐ 372B ☐ 382
☐ 385 ☐ 431

☐ Have a sales engineer call for an appointment.

Norden-Ketay Corporation • Stamford, Connecticut

NAME_____ TITLE_____

COMPANY_____

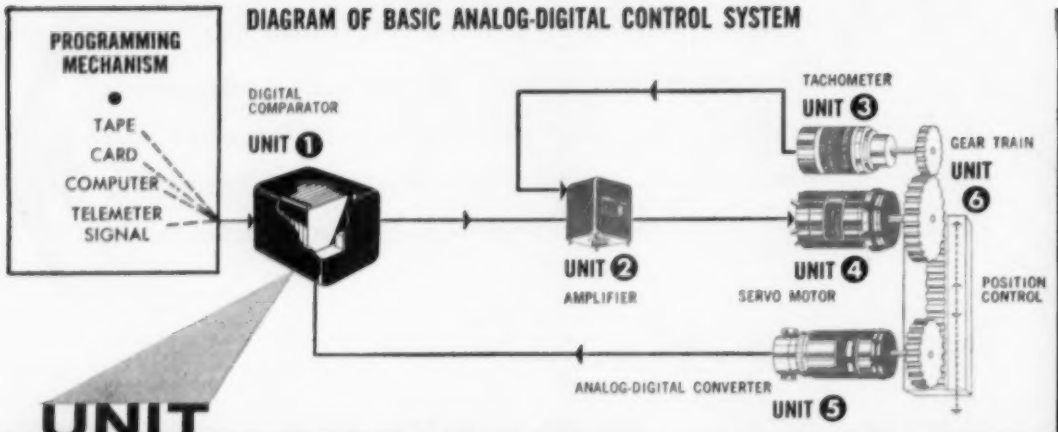
STREET_____

CITY_____ STATE_____

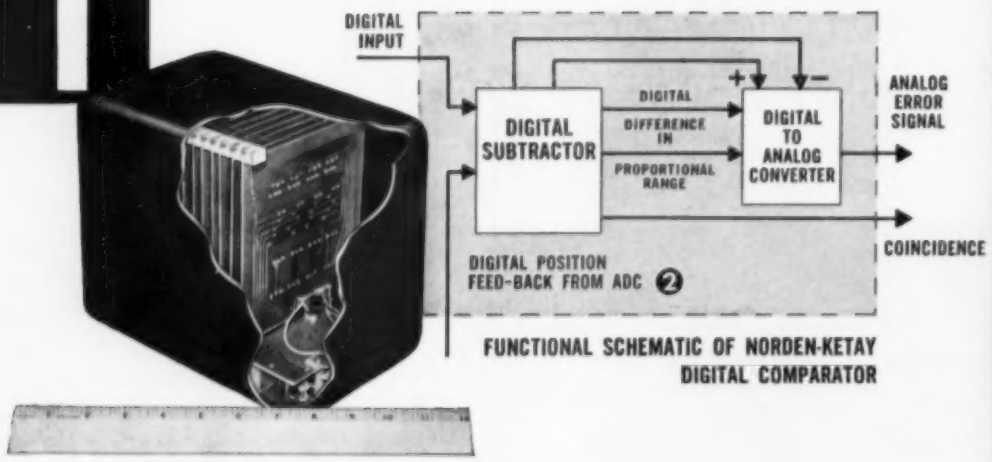
SALES OFFICES

N K

Baltimore, Maryland
Stamford, Connecticut
Washington, D.C.
Dayton, Ohio
Denver, Colorado
Chicago, Illinois
Gardena (Los Angeles), Cal.




# UNIT 1 DIGITAL COMPARATOR




FUNCTIONAL SCHEMATIC OF NORDEN-KETAY DIGITAL COMPARATOR

## New design permits true digital control with conventional servo motors and amplifiers

Norden-Ketay has packaged a new Digital Comparator that works with standard servo units to give servo systems the stability and reliability of digital control techniques. Used with N-K 13-bit and 19-bit analog-digital converters, the Digital Comparator simplifies circuitry and provides absolute reference by eliminating pulse counting.

In operation, a binary feedback signal indicating position of the controlled device is fed to the comparator by the ADC. This signal is compared with a parallel binary signal encoded from tape, cards, computer, or other command source. Lack of coincidence between the programmed and actual positions produces an error-modulated AC output. This signal indicates the magnitude and direction of the positional error and activates the servo motor to drive the device to coincidence.

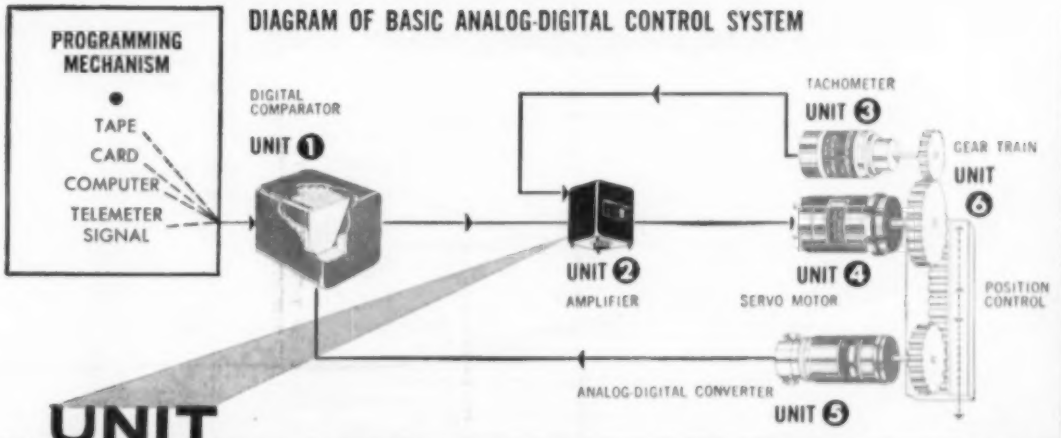
100% transistorized, printed circuit design eliminates tubes and relays, making possible a rugged package for severe environments, with great flexibility in range and configuration. By effectively bridging the gap between digital programming and analog control, the Digital Comparator opens up a wealth of possibilities for simplified solutions to difficult control problems.

*Send coupon on page 87 for Bulletin #418 containing data on Digital Comparators.* Norden-Ketay Corporation, Western Division, 13210 Crenshaw Boulevard, Gardena, California.

### GENERAL SPECIFICATIONS

**Weight: 10 lbs. Voltage req'd: −13, −11, +2 VDC; 115 VAC. Input: 13 and 19 bits. Output signal: 60 cps to 1000 cps.**

N K NORDEN KETAY




# UNIT 2 SERVO AMPLIFIERS

## Wide choice of Norden-Ketay amplifiers permits exact matching of units with servo motors

Servo amplifiers are available to drive the complete line of Norden-Ketay servo motors, varying from size 8 (1.75 watts, control phase) to size 23 (16 watts, control phase). High gain, low response time, and compact size are outstanding characteristics, resulting from the unique design features introduced by Norden-Ketay.

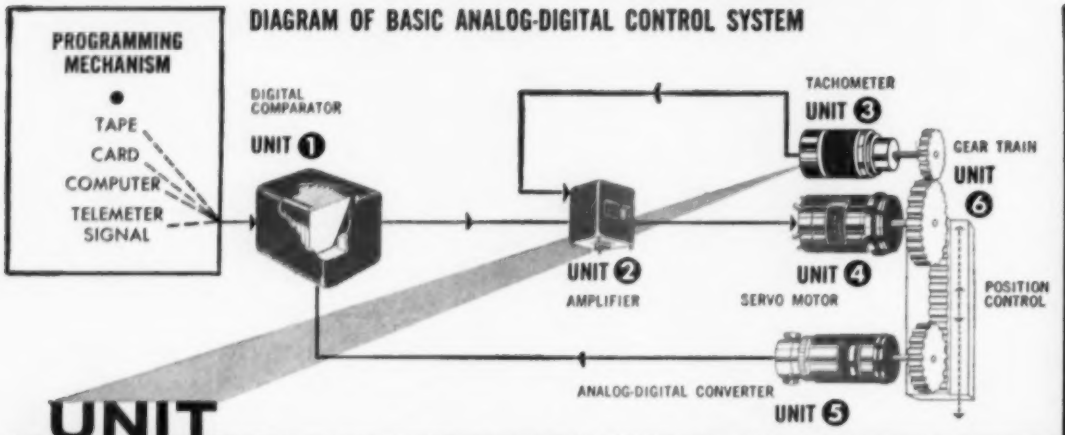
The standard selection includes amplifiers of electronic, magnetic, and transistor types. Transistorized resolver amplifiers, combined with N-K precision resolvers, can achieve overall system accuracy better than 0.07% from −55° to +110°C.

To broaden the system designer's field of operation, modifications of standard units are available to provide satisfactory operation over a wide range of ambient temperatures (−55°C to +125°C), and under adverse environmental conditions.

Where standard units do not meet your particular requirements, Norden-Ketay welcomes requests for the design of special amplifiers.

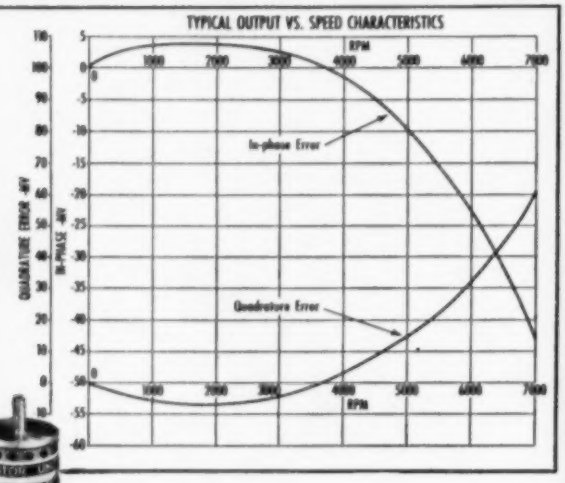
*For Bulletin #382 with full information on amplifiers, send coupon on page 87.* Norden-Ketay Corporation, Precision Components Division, Commack, Long Island, N.Y.

N K NORDEN KETAY




# UNIT 3 TACHOMETERS

Variations can be specified in tachometer dimensions, voltages, frequency, shafts, and lubrication for extreme temperatures.




## Tachometers present the designer with a new range of possibilities for control systems

Norden-Ketay offers tachometers designed for accurate computations and for use in velocity servo systems and stabilizing systems. Units are pre-aged to insure lifetime stable operating characteristics.

Norden-Ketay's integrating tachometers assure extremely accurate computations over a wide range of ambient temperatures.

The voltage output is pre-trimmed to ±0.2%, saving the systems engineer considerable time and money when installing a tachometer into a new system or replacing tachometers.

Linearity of ±0.12% of the voltage output at 3600 RPM from 0 to 4000 RPM. Temperature compensation holds output gradient to ±0.3% from −55° to +80°C. This compensation is done with a passive network which increases reliability, eliminates radio noise and phase shift problems that occur with a thermostat-controlled heater unit. Extremely high ratio of signal to in-phase fundamental null voltage of over 800 to 1. For extremely precise integration, a magnetic amplifier-controlled heater holds output gradient to ±0.02% over a temperature range of −55° to +80°C.

For damping tachometer purposes Norden-Ketay has improved the basic Mark 12 and Mark 16 types by providing internal features that insure greater reliability, stability, and lower null voltages.

*Send coupon on page 87 for Bulletin #423 containing data on wide selection of Tachometers.*
Norden-Ketay Corporation, Precision Components Division, Commack, Long Island, N.Y.

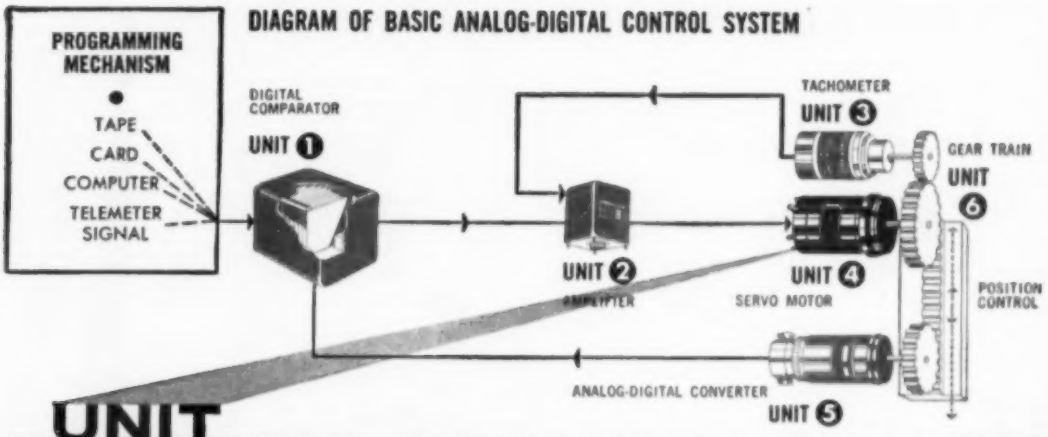
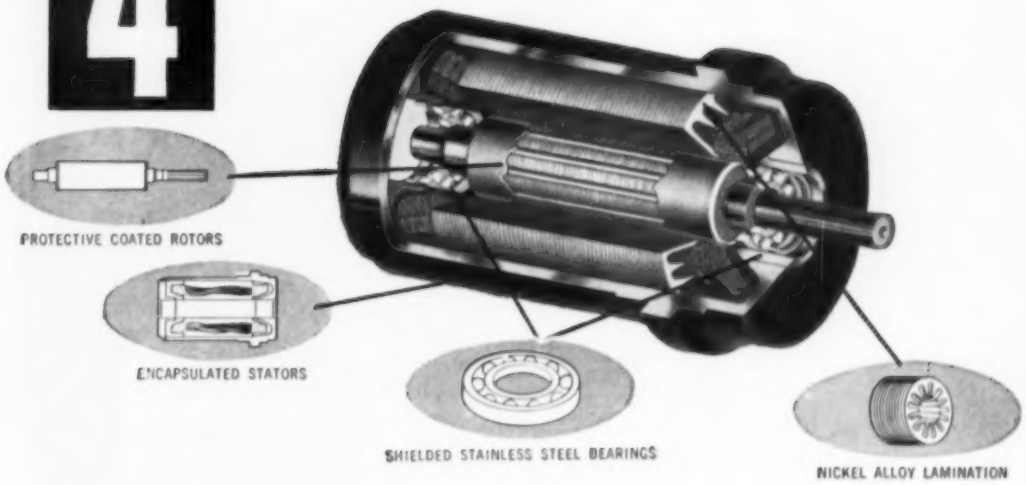



DIAGRAM OF BASIC ANALOG-DIGITAL CONTROL SYSTEM

# UNIT 4 SERVO MOTORS




## High torque-to-inertia ratios of Norden-Ketay servo motors give fast, precise response

The ability to correct error rapidly and precisely in minute increments recommends Norden-Ketay servos for control systems where a combination of high torque and reliability are important. High acceleration, smooth performance at near-stall conditions, and operation at low control voltages assure fast, dynamic servo response.

A complete range of sizes and types enables the designer to fill his requirements in size, characteristics, and special construction features with standard Norden-Ketay units. Diameters of .750" (size 8) to 2.250" (size 23) are available. Standard 400 cycle motors have stall torques varying from 0.25 to 7.0 inch-ounces, while 60 cycle units are rated from 1.45 to 7.0 inch-ounces.

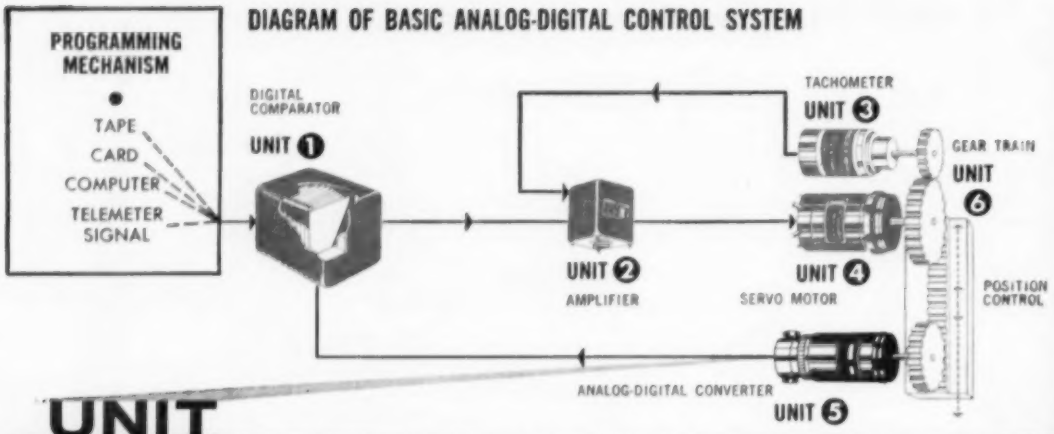
Special design features in standard models provide a variety of shaft extensions and control voltages. Control phases can be driven directly from vacuum tube plates or from transistors. Units can be supplied with low input power requirements for the control phase, to control the performance of a relatively large motor.

Norden-Ketay servos can be combined with gear trains or tachometers to produce geared servomotors or geared servomotor-tachometer generators.

The availability of these design variations in a complete size range of standard motors simplifies system design, reduces component costs, and speeds delivery.

*Send coupon on page 87 for Bulletin #385 containing data on Servo Motors.* Norden-Ketay Corporation, Precision Components Division, Commack, Long Island, N.Y.

DIAGRAM OF BASIC ANALOG-DIGITAL CONTROL SYSTEM




# UNIT 5 DIGITAL CONVERTERS

## Unique dual-brush logic increases system versatility and simplifies circuit design

Encoding of brush selection logic on the binary disc in the Norden-Ketay Analog Digital Converter (ADC) simplifies control systems by eliminating external circuitry otherwise required for unambiguous readout.

The simultaneous availability of both digit and complement allows two-directional operation with increasing count in both directions, simplifies subtraction and error-checking circuitry, and permits direct push-pull drive of bi-stable output networks.

The large digital capacity of the Converter provides sufficient digital increments to locate position and measure error with virtually any desired degree of precision up to one part in 524,288. This extreme precision is achieved without sacrifice of stability (as in the case of conventional analog systems) because of the positive on-off operation of the digital circuits, which are not subject to drift or noise-induced errors. The position indication is unique for every point. No errors can occur due to lost pulses, supply voltage transients, or even a power failure during which time the encoder position is changed.

PERFORMANCE FEATURES

| | |
|---|---|
| ADC-7-BNRY<br>ADC-13-BNRY<br>ADC-19-BNRY | Unambiguous, natural binary encoders, designed as airborne, multi-turn, digital servo components. 128 counts per turn; total ranges to 524,288 counts. |
| ADC-2-BCD<br>ADC-3-BCD<br>ADC-4-BCD | Unambiguous 8-4-2-1 binary-decimal encoders. 100 counts per turn; total counts of 2, 3, 4 decimal digits. |
| ADC-28-16 | Unambiguous, natural binary encoder with capacitance sensing of low-order digits. $2^{11}$ counts per turn; $2^{16}$ total counts, for guidance and control, antenna position digitalizing. |

These ADC units meet military specifications. Cyclic binary encoders and other encoding devices for special applications can be ordered for particular requirements. *Send coupon on page 87 for Bulletin 372B containing data on Norden-Ketay Analog Digital Converters.* Norden-Ketay Corporation, Instrument & Systems Division, Milford, Conn.

N K
NORDEN KETAY

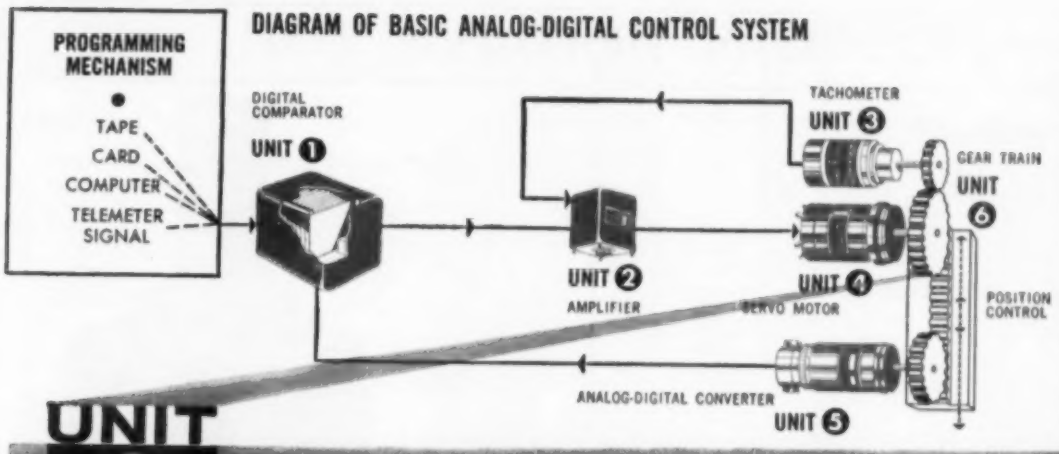
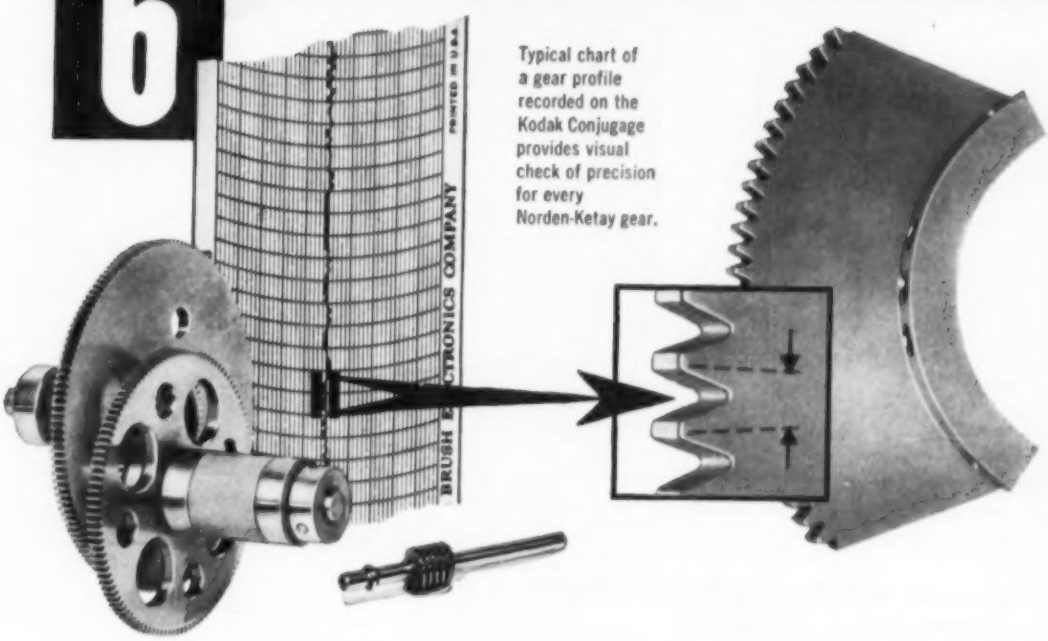



DIAGRAM OF BASIC ANALOG-DIGITAL CONTROL SYSTEM

UNIT 6

# GEAR TRAINS




Typical chart of a gear profile recorded on the Kodak Conjugage provides visual check of precision for every Norden-Ketay gear.

## Precision gear trains maintain high accuracy of servo systems to exact performance requirements

To maintain the high level of accuracy developed by Norden-Ketay components in control systems, the Florida Gear Division produces a full range of Gear Trains to precision tolerances.

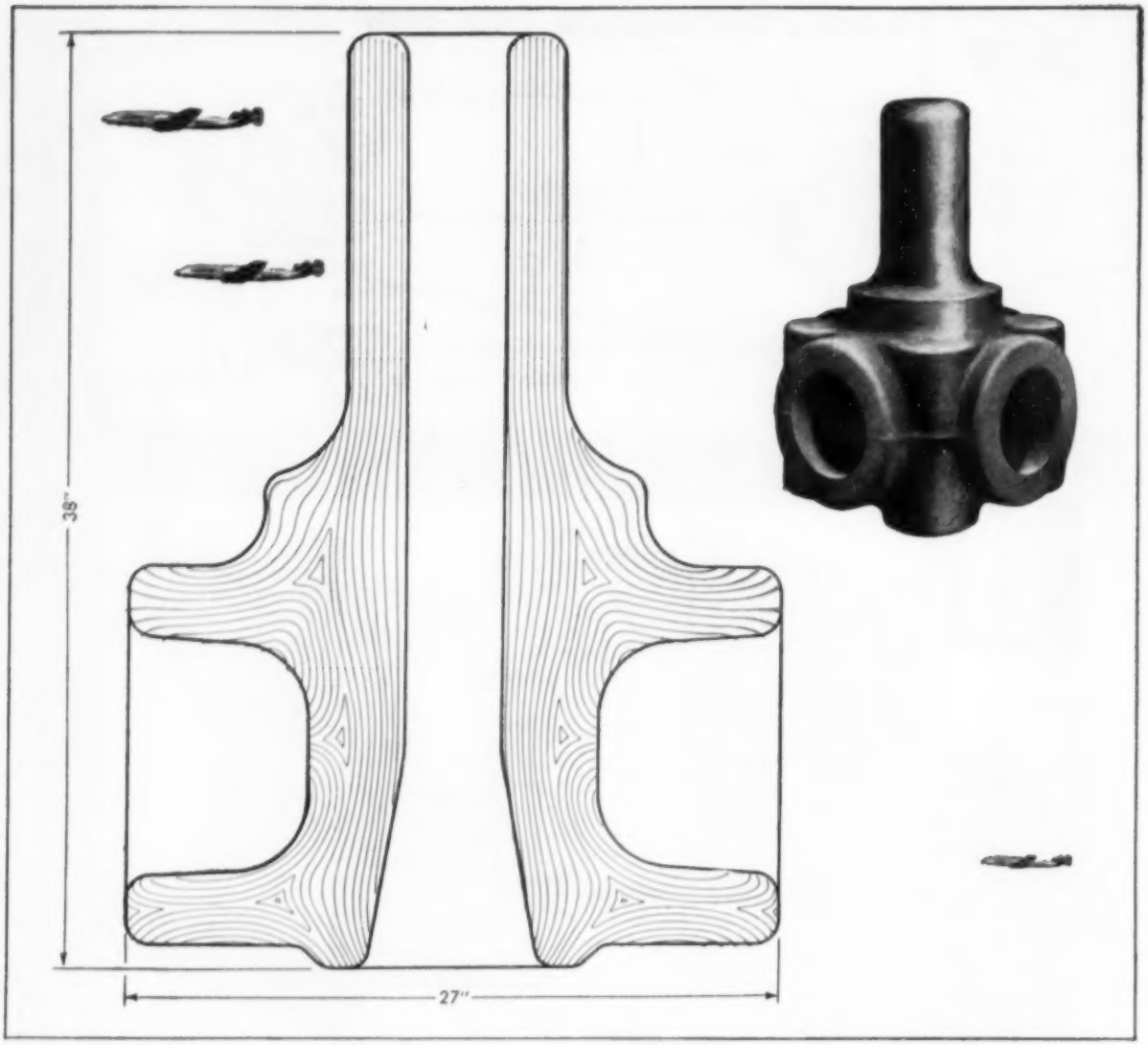
With skills and facilities capable of cutting, shaving, and grinding gears from 3 to 200 D.P., to meet the exacting requirements of military specifications, Norden-Ketay has the precise answer to every gearing problem.

Extensive experience in gear engineering design for major military projects is an important asset of the Florida Gear Division in tailoring gear assemblies to the particular demands of high performance systems.

Application engineers are on call to go over your gearing requirement with a view toward obtaining the desired results with the simplest and most efficient gear combination.

*Write to: Norden-Ketay Corporation, Florida Gear Division, Miami, Florida, or send coupon on page 87 for Capabilities and Facilities Bulletin #431.*

CONTROL COMPONENTS




## THE SPLIT-DIE FORGING SOLUTION FOR TURBOPROP TORSION

This big Turboprop propeller hub for Curtiss-Wright was turning up a storm in design circles. Specifications called for 2680 lbs. of A.I.S.I. 4355 modified aircraft quality steel to be forged and heat treated to high strength levels, all of which is not unusual except for one thing. The tremendous power transmitted through the neck section of the hub subjected this area to unusual stresses. Grain structure was a prime consideration. This presented a problem because conventional forging methods could not produce the desired grain flow pattern.

The Cameron split-die forging process solved the problem for Curtiss-Wright. In a single pass through Cameron's largest side-ram press, a glowing billet was pierced from six different directions and changed into the near final shape shown above. Grain structures were exactly right. As an added benefit, far less machining time was required to complete the hub.

This hub is a striking example of Cameron's ability to economically solve design problems through the use of a new forging concept. Shapes and sizes formerly considered impossible to forge in closed dies have become routine procedure with this revolutionary technique. If you have a component problem that forces you to accept castings where forging quality is desired, or if conventional forging processes fail to give you the metallurgical quality or economy that you require, write, call or come by . . .

Cameron
IRON WORKS, Inc.
SPECIAL PRODUCTS DEPARTMENT
P. O. Box 1212, Houston, Texas

# NEW AVIATION PRODUCTS

## Flight Line Test Set

Set for flight line checking of aircraft pressure instruments and systems simulates two types of pressure probes and generates selected pitot and static pressures for testing altimeters, Machmeters, airspeed indicators and true airspeed computers.

Self-contained equipment weighs 85 lb. and can be operated by unskilled personnel. Range is from 100 to 1,000 kt. and −1,000 ft. to 80,000 ft. Accuracy is said to be ±1% airspace; ±1% or ±35 ft. of altitude.

**Norden-Ketay Corp., Commerce Rd., Stamford, Conn.**

## Missile Sequencer

Motor-driven sequencer switching device especially designed for missileborne operation, is designed for rocket motor ignition, flares, starting of equipment and sequencing of internal instrumentation calibration signals. Unit has been used extensively in two sounding rocket programs, according to the manufacturer.

System consists of a miniaturized 28 v. d.c. constant speed motor attached to a planetary gear box which rotates a wiper arm across equally spaced contacts located on a printed circuit. It will work during and after acceleration loads exceeding 100G and at altitudes of more than 100,000 ft. Weight of complete unit is two pounds; it measures three inches in diameter and is six inches long. Motor is 28 v. d.c., constant speed.

**Era Engineering, Inc., 1009 Montana Ave., Santa Monica, Calif.**

## Motor for Mach 2 Operation

Air motor power actuating source that operates at temperatures exceeding 1,000F without conventional lubrication or cooling is applicable to Mach 2 aircraft and missiles, the maker reports.

Cam-piston design is a positive-displacement fluid-driven power device using hot compressed air. A typical model of three being produced stands three inches high, is 13 in. long, weighs 22 lb. and develops 18.5 hp. Design flexibility permits development of from one to 300 hp. sizes, it is stated.

Extremely hard, wear-resistant alloys make it possible to operate without need for lubrication. Current three models are designated CM-710, CM-350 and CM-160, these developing 18.5, 9.1 and 4.2 hp. respectively at 200 psig. and 1,200 rpm.

**Manufacturer: AiResearch Manufacturing division, The Garrett Corp., Phoenix, Ariz.**

## Profiler for P6M

Extra-heavy-duty vertical profiler and milling machine has been delivered to the Martin Co. for turning out large detail parts for the P6M SeaMaster four-jet flying boat. Either aluminum or steel details can be automatically profiled or milled on the machine, which has an electro-hydraulic three-dimensional tracer.

Table is 48-in. wide x 120-in. long with a 124-in. travel. Throat depth is 66 in. and transverse movement of cutter head is 60 in. Vertical travel of spindle is 12 in. There are 16 spindle speeds from 20 to 3,600 rpm.

**Morey Machinery Co., 383 Lafayette St., N. Y.**

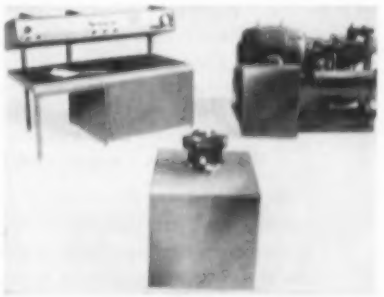
## Small Bomb Hoist Handles Big Loads

**New Aero 17A portable electrical bomb hoist weighs 47 lb., yet is capable of lifting stores weighing up to 2,500 lb. at the rate of 15 fpm., according to Douglas Aircraft-El Segundo engineers, who designed the unit. Used in pairs, the hoists can lift 5,000-lb. loads. Aero 17A is designed to lift stores up to 13 ft. within 1/32-in. accuracy. Normal operation requires a single electrical cable connected to either a deck-edge receptacle or portable power unit; if there is no power available, a hand crank will raise or lower a 2,500-lb. store. Douglas technicians are shown loading a large bomb onto a A4D Skyhawk's external wing rack.**

## Equipment Shake Unit

Utilizing electronically controlled hydraulic power, new Hydrashaker vibration excitation system is stated to provide more accurate simulation of operating conditions imposed upon equipment slated for modern weapon systems use.

Unit was initially developed by

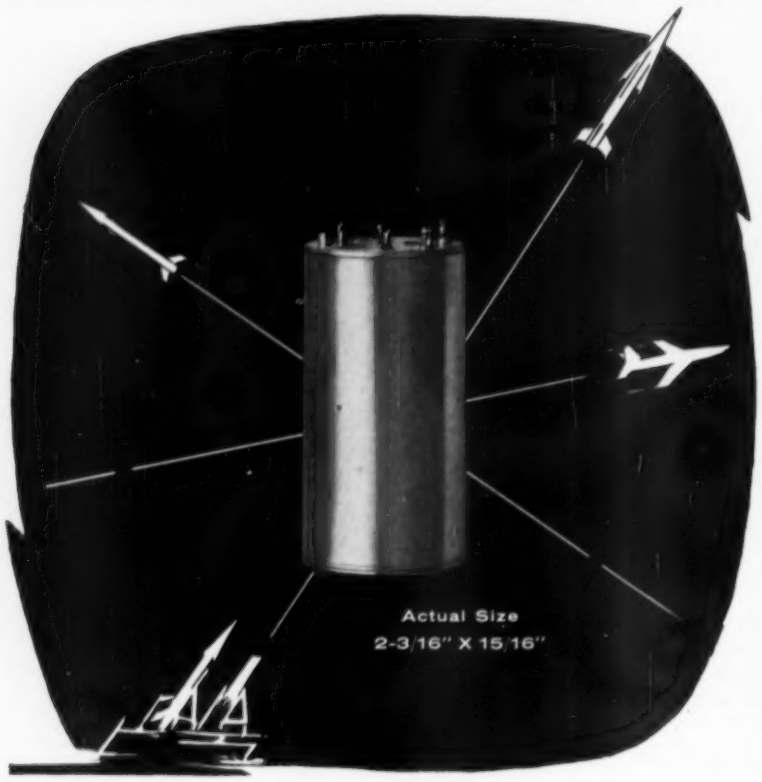


Northrop Aircraft, Inc., and licensed to current manufacturer. Moving-assembly portion of the equipment weighs 16 lb., yet it has a force capacity effectively much greater than other types with similar assemblies weighing up to 275 lb.

Range of capabilities is illustrated by typical data: 100G acceleration with 25-lb. specimen weight, 85G with 100

## *Now in mass production . . .*

## SANDERS Subminiature RATE GYRO




To meet the growing demand for reliable control and stabilization elements, Sanders Associates is now mass-producing the Sanders sub-miniature rate gyroscope.

Exacting applications in aircraft, missile and fire control have proved conclusively the complete reliability of this rate gyro in a wide range of conditions and environments. Its features include:

- **Torsion bar suspension for fast response to minute signals**
- **Resolution of 0.001% full scale**
- **Compensated for environmental conditions**
- **Fluid cushioning to minimize vibrational shock**
- **Rotary multi-pole differential pickoff for higher sensitivity and excellent resolution**
- **Full scale ranges available up to 400° per second**

Sanders' direct distribution offers the long experience of Sanders engineers. Their assistance can be invaluable in reviewing your gyro design and application problems. Whether your problem is on selection of a gyro or a complete gyro control package, our Application Engineers are available to serve you.

SANDERS ASSOCIATES INCORPORATED Dept. J, NASHUA 10, NEW HAMPSHIRE

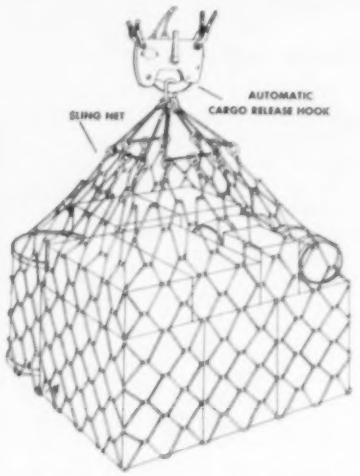
*West Coast Field Office:* 1608 WEST CENTINELA BLVD., INGLEWOOD, CALIFORNIA


lb. and 17G with 1,000 lb. Frequency ranges up to 2,000 cps. depending upon specimen weight. Among features of unit mentioned by the manufacturer are low maintenance because metal-to-metal contact is eliminated by having all moving parts in the hydraulic amplifier supported hydrostatically.

**Manufacturer: Wyle Manufacturing Corp., 124 Maryland St., El Segundo, Calif.**

### Cargo Sling Nets

Metal cable cargo sling nets for helicopter and general materials handling applications are of 2,500-lb. and 5,000-lb. capacity. Nets are box-type, using either stainless steel or galvanized aircraft cable. Units are designed so

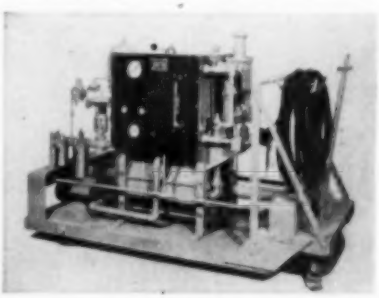



they won't tangle, are compact for storage, weigh half as much as rope nets of comparable size and capacity, will not pick up moisture and are easy to load because sides collapse around periphery of net's base.

**Eastern Rotorcraft Corp., 400 Swamp Rd., Doylestown, Pa.**

### Aircraft Test Stand

Aircraft test stand line adaptable to hydrostatic and functional testing is available in stationary or portable models. Reciprocating demand-type pumps deliver hydraulic fluid under pressure as required; pressure is maintained under full-flow or no-flow conditions



while pump is almost motionless. When high flow rate is needed, unit delivers volumes required by demand.

Long, high-pressure holding characteristics of the pump permit accurate checking and calibration of instruments involving low volume.

**Ledeen Manufacturing Co., 3350 N. Gilman Rd., El Monte, Calif.**

### Portable D.C. Power Supply

Portable regulated d.c. power supply units can be used for on-the-line or shop checking of aircraft electronic equipment. Model PR-100 weighs 22½ lb., PR-200 weighs 25½ lb. Former provides d.c. output of 120-300 v.,

0-100 ma.; latter 120-300 v.; 0-200 ma. For line variations of 105-125 v. a.c., regulation is 0.5%; load regulation from none to full load is 0.1%.

Internal impedance is less than four ohms; ripple and noise characteristics are less than five m.v. rms.

**Nutron Manufacturing Co., Inc., 67 Monroe Ave., Staten Island 1, N. Y.**

### High Strength Bolt Recess

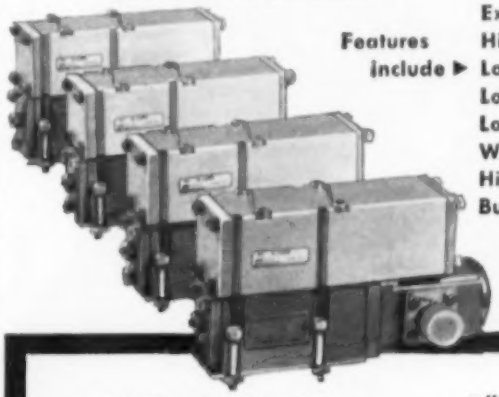
Multitork is a cold-headed recess for use in high-strength flush-head bolts. Advantages of the recessed bolts include greater torsion strength, up to 50% increased fatigue life and reduced breakage during installation and maintenance, the maker reports.

Multitork unit is simply two uniformly radiused slots separated by a web, a portion of the bolt head. Unit's design

## *Now in mass production . . .*

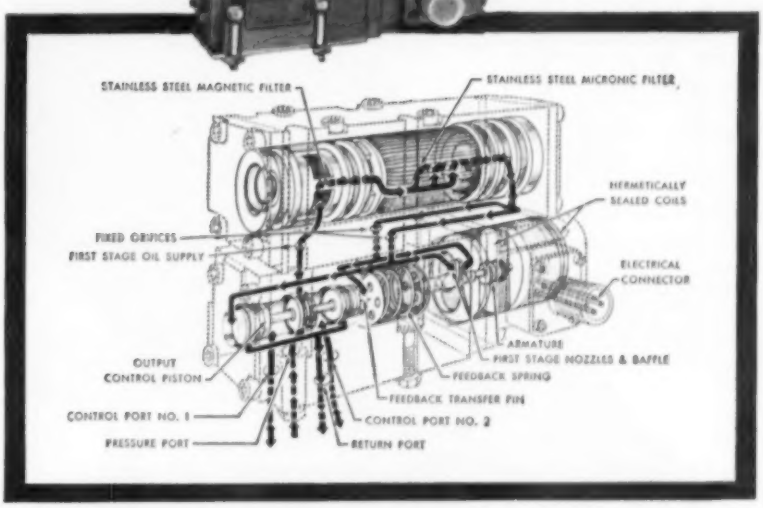
## SANDERS SA-19 SERVO VALVE

The Sanders SA-19 Servo Valve provides unparalleled efficiency and reliability for a wide variety of electro-hydraulic components and systems. Utilizing the Sanders internal force feedback principle, this two-stage electro-hydraulic amplifier develops large hydraulic output flows with relatively low input electrical power requirements.



**Features include ▶**

- Excellent Resolution
- High Power Amplification
- Low Hysteresis
- Low Threshold
- Low Input Power
- Wide Frequency Response
- High Stiffness of Control
- Built-in Filtration




Operation: An input current, converted to a magnetic force in the First Stage Armature, moves the First Stage Baffle between two nozzles causing a pressure differential across the ends of the Output Control Piston. The resulting motion of the Output Control Piston is fed back through the Transfer Pin and Feedback Spring as a restoring force on the First Stage Armature, thus nulling the valve and porting oil to the load. The First Stage Oil Supply is thoroughly filtered as shown.

**TYPICAL SPECIFICATIONS:**

| | |
|---|---|
| Coil Resistance (ohms/coil) 3000 | Amplitude Ratio within 3 db at 100 cps |
| Differential Current ±20 ma | Phase Shift 90° at 100 cps |
| Flow (GPM @ 1000 psi across valve) 8 | Resolution (% of Full Signal) ±0.2 |
| System Pressure (psi) 3000 | Hysteresis (% of Full Signal) ±3.0 |

*Write today for complete information.*

SANDERS ASSOCIATES INCORPORATED Dept. J, NASHUA 10, NEW HAMPSHIRE

*West Coast Field Office:* 1608 WEST CENTINELA BLVD., INGLEWOOD, CALIFORNIA

# first

*Burroughs is first with the full power of a giant electronic computing system at half the cost... the Datatron 220.*

First too, a medium-priced system with a full magnetic core memory, increasing productivity 10 to 15 times over previous systems. Designed for *both* scientific computation and business data processing. Delivery of the Datatron 220 will begin during the 2nd quarter of 1958. For a summary of its benefits, write to Dept. H, Pasadena, California:

Burroughs

**ElectroData** DIVISION

**BURROUGHS CORPORATION**

GRAPHIC • MECHANICAL • ELECTRO-MECHANICAL • ELECTRONIC SYSTEMS

*extending the usefulness of man's mind*

simplifies removal of skin smoothing compounds, it can be headed in tool steels, Vasco-jet and new "super" alloys. It is offered in bolt sizes of ¼-in. through ⅜-in. shank diameters.

**Briles Manufacturing, El Segundo, Calif.**

### Turbine Wheel Balance

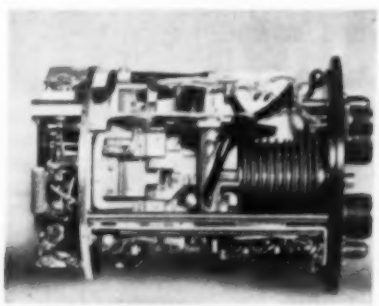
Machine for balancing single-stage turbine wheels in rotation generates sufficient centrifugal force to locate the blades in their operational position; unbalance is then indicated on a meter in grams, ounces or any other unit of

correction. Angular position of unbalance is also shown in degrees on a scale inside the housing. Single level controls entire operation cycle.

**American Trebel division, Kurt Orban Co., Inc., 22 W. Putnam Ave., Greenwich, Conn.**

### Machmeter-True Airspeed

Machmeter and true airspeed indicator Model 1003-0100 covers a 100-1,000-kt. speed range with accuracy of ±¼ kt., is 5¼-in. in diameter, is 7⅞-in. long and weighs six pounds. Model 1022-0100 covers a Mach number range of .5 to 1.5, standard sensitivity




**NEW, Pyrometer Indicator**

**Null Balance, Potentiometer Type**

**MINIMITE**

**Has 23½ Inch Double Scale**

**Small Size** Extremely small and compact, this null balance Portable Potentiometer Indicator weighs under four lbs. and measures only 4" x 5" x 6".

**Scale Range** Despite its small size the "MiniMite" has a 23½ inch double range scale. There are 15 available scales for all standard thermocouple materials. These scales include temperature ranges from —300°F. to +3200°F. and millivolt ranges from 0 to 62. Measuring accuracy is ¼ of 1% of scale range.

**Dual Application** The "MiniMite" can measure temperature directly when connected to a thermocouple, or check other potentiometer or millivoltmeter-type instruments when used as a calibrating instrument.

*Write for Bulletin 64-C.*

**Thermo Electric Co., Inc.**
SADDLE BROOK, NEW JERSEY
In Canada—THERMO ELECTRIC (Canada) Ltd., Brampton, Ont.



**STURTEVANT TORQUE TESTING FIXTURE**

**FOR TESTING** Screws, thread-cutting and thread-forming screws—all types of threaded fasteners; threaded parts and threaded connections.

**FOR MANUFACTURERS**
**DESIGNERS**
**INSPECTORS**
**TOOL ENGINEERS**
**LABORATORIES** and for
**PRODUCT CONTROL**
in assembly.

Capacities: (0-200 in. lbs.) or (0-150 ft. lbs.)

*Write for Bulletin TTF*

P. A. Sturtevant Co. Addison Quality Illinois



*...almost spaceless*
(1 cu. in.)

**Giannini**

# AMPHENOL TEFLON*

*DUPONT TRADEMARK

## 3 EXTRA STEPS for RELIABILITY

AMPHENOL's high temperature Teflon Hook-Up Wire is made to MIL-W-16878B—an exacting specification that requires rigid manufacturing and testing procedures. In addition to these requirements, AMPHENOL supplements the specification with even more stringent testing to assure the most reliable wire product available.

In Manufacturing—AMPHENOL *maintains a constant check during extrusion of the Teflon to be sure that the insulation is* always *concentric.*

In Materials—AMPHENOL *uses a* minimum *of 40 microinches silver plating on all wires.*

In Inspection—AMPHENOL *tests every foot of finished Hook-Up Wire for reliable operation at rated and higher voltages.*

These extra steps are important to users. Concentric insulation provides clean wire stripping—no damage to the conductor wires. The full coverage of silver plating assures faster, easier tinning—and reliable soldered connections. 100% inspection for dielectric strength is the most effective guarantee of reliable performance—the reliability you must have in Hook-Up Wire.

AMPHENOL *Industrial Distributors carry stocks of standard* AMPHENOL *components in order to provide immediate service to your rush requirements.*

AMPHENOL

AMPHENOL ELECTRONICS CORPORATION
*chicago 50, illinois*
AMPHENOL CANADA LTD. *toronto 9, ontario*


for Mach number output is ±.003. Sensitivity of ±.001 can be had on special order. Standard units are designed to operate to 60,000 ft.

Unit is part of a complete air data system. Modular construction permits mating with the MTB No. 1031-0100 altitude and vertical velocity meter.

**M. Ten Bosch, Inc., Pleasantville, N. Y.**

### Three-Way Warning Light

Warning light for aircraft systems incorporates three functions: flashing light, steady light and press-to-test. Flash rate is 100 counts/min. ±10% over the voltage and temperature range. Operational range is from 14 v. to 32 v. d.c. and −55C to 71C. Unit meets MIL-K-8144.

Weight is 1¾ oz. It is ⅞-in. diameter and requires three inches depth behind the panel.

**Jordan Electronics Co., 3025 W. Mission Rd., Alhambra, Calif.**

### New Vacuum Furnace

New 50-to-300-lb. vacuum induction melting furnace, designated Type FIM-300, features wide flexibility for a variety of applications, the manufacturer reports. Unit has an 8-ft.-long, 5-ft.-diameter chamber, a 2,900 liter/sec. diffusion-ejection pump, a 310-cfm. mechanical pump, and control center. Mold well is flanged, can be built to any desired depth and is easily exchanged with bolt-on accessories. Standard well accommodates molds 48 in. high. Mold table permits 42-in. molds.

Charges to crucible are handled by a solenoid-controlled feeder which can handle lump or fine dust material.

**Consolidated Electrodynamics Corp., Rochester Division, 1775 Mt. Read Blvd., Rochester 3, N. Y.**

### Lox Quick Disconnect

Quick disconnect couplings with and without self-sealing members in each coupling half for use in aircraft liquid oxygen systems are currently being tested by Air Crew Equipment Laboratory, Naval Air Experimental Station, Philadelphia.

Units are made of corrosion-resistant materials and incorporate Teflon or

## Why aircraft designers specify Formsprag Over-Running Clutches for maximum torque — minimum weight

More and more, in modern aircraft manufacture, design engineers find themselves facing this challenging dilemma; how to pack more and more performance into less and less space.

One obvious answer: select smaller, lighter components capable of bettering bigger component's output. This is why so many designers are contacting Formsprag when they have power transmission applications.

They have discovered these vital advantages built into each truly modern Formsprag clutch: more torque capacity with less weight providing greater payload than any other over-running clutch . . . high efficiency . . . internal design simplicity . . . no measurable backlash.

Perhaps you too have a project on which the performance vs. size problem could be solved by Formsprag design engineers. Formsprag over-running clutches are widely used as component parts of gas turbine starters, alternator drives, rudder and landing gear actuators, hoists, and helicopter transmissions. For engineering design assistance simply write Formsprag Company. Ask, too, for the new paper titled "Design Considerations for High Speed Over-Running Clutches".

*Over-Running, Indexing and Backstopping Clutches for aircraft, automotive and various industrial applications.*

# FORMSPRAG COMPANY

23593 HOOVER ROAD, WARREN (DETROIT), MICHIGAN

*World's largest exclusive manufacturer of over-running clutches. Distributors in principal cities.* A9-10C

# PILOTS PROVE ABILITIES IN *Powder Puff* DERBY

**FIRST** Pilot: Alice Roberts, right
Co-pilot: Iris Critchell
Plane: Beechcraft Bonanza

**SECOND**
Pilot: Doris Eacret, left
Co-pilot: Jean Parker Rose
Plane: Cessna 140

**FOURTH**
Pilot: Ruby Potter, right
Co-pilot: Marion Craver
Plane: Beechcraft Bonanza

## THREE OUT OF FOUR WINNING PLANES WERE SPARKED BY AC!

From San Mateo, California to Philadelphia, Pennsylvania, the 1957 All-Woman Transcontinental Air Race winged its way 2,567 miles! Throughout the race, the crews demonstrated skill and judgment to get the most out of plane performance and weather conditions. Decisions were their responsibility!

When the wheels touched down at the Philadelphia Airport, three of the first four planes in the Powder Puff Derby had been powered to victory by AC Spark Plugs. Yes, ACs were tops in one of the nation's top-flight private-plane contests. The extra reliability and performance of AC Spark Plugs have been proved in millions of hours of flight in military, commercial and private planes.

You'll find AC Aircraft Spark Plugs best for the plane you fly!

SH-83P ILLUSTRATED

FLYING STARTS WITH . . .

AC

**AIRCRAFT SPARK PLUGS**

AC SPARK PLUG — THE ELECTRONICS DIVISION OF GENERAL MOTORS

GM GENERAL MOTORS

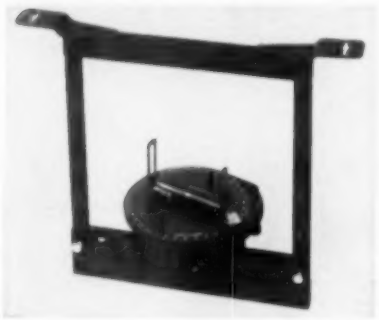
***DISTRIBUTED BY:*** **Airwork Corporation:** Millville, New Jersey; Miami Springs, Florida; Newark, New Jersey; Atlanta, Georgia; Alexandria, Virginia; Cleveland, Ohio. **Pacific Airmotive Corporation:** Burbank, California; Seattle, Washington; Oakland, California; Kansas City, Kansas; Denver, Colorado; Linden, New Jersey. **Southwest Airmotive Company:** Dallas, Texas; Kansas City, Kansas; Denver, Colorado. **Standard Aero Engine Ltd.:** Winnipeg, Manitoba; Vancouver, B.C.; Edmonton, Alberta. **Van Dusen Aircraft Supplies, Inc.:** Chicago, Illinois; Minneapolis, Minnesota; Teterboro, New Jersey; East Boston, Massachusetts; Alexandria, Virginia; Richmond, Virginia.

Kel-F seals. They are designed to operate freely with either liquid oxygen or liquid nitrogen at −320F; visual aids indicate when the unit is in locked position. There is no measurable external leakage when unit is connected even though the lines contain liquid at pressures of more than 110 lb.

**Essex Manufacturing Co., Inc., St. Louis, Mo.**

### Light Compass Rose

Magnarose, an aircraft compass rose system, can be operated from the cockpit by taxiing the aircraft into the desired position, eliminating extra outside



personnel if necessary. Ground unit weighs only 10 lb. and is portable. Orientation to accuracy of 1/10 deg. is possible if required.

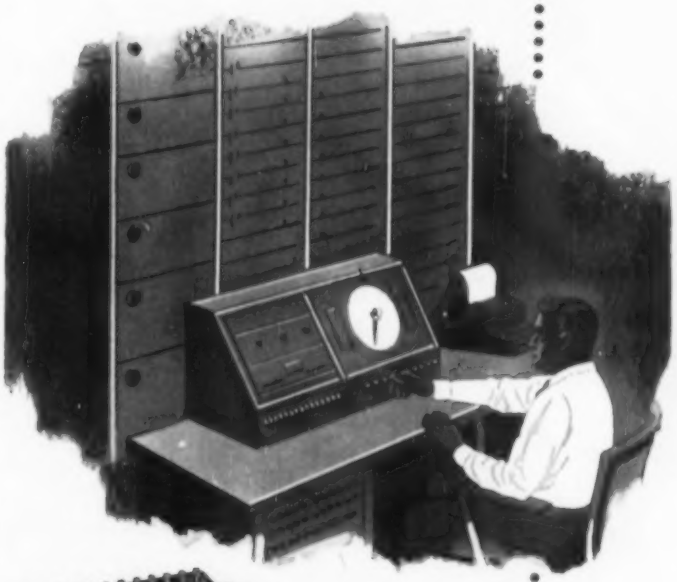
**Eastern Air Navigation Service, 157 W. 54 St., New York 19, N. Y.**

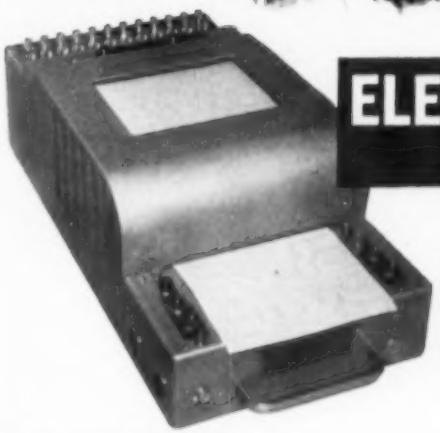
### Emergency Strip Light

Blue-white two-way flasher light for outlining emergency landing strips has a visibility range of from two to five miles, according to the manufacturer. Operations cost is approximately a penny a day. During testing by an independent laboratory, the unit provided 2,600 hr. of continuous operation on a $1.15 battery, the maker reports.

**Gen-A-Matic Corp., Van Nuys, Calif.**


**computer time saved with**





**ELECTROGRAPH**
**MODEL 420**

*Visual editing of tape-recorded intelligence through use of Electrograph records saves many hours of valuable computer time.*

**24-channel Electrophotographic Recording Oscillograph**

Now you can edit telemetered tape-recorded information and select the data to be fed into the data reduction computer. As many as 24 channels of tape signals connected to the Electrograph galvanometers through appropriate discriminators may be recorded simultaneously. The analog record is instantly readable as it is discharged from the recorder. Proper keying of the permanent record to the tape permits visual selection of the data to be placed into the computer.

Records produced by the Electrograph are permanent, requiring no further processing, and may be stored indefinitely without loss of trace definition.

For further information regarding the Electrograph, you are invited to write, wire or call for bulletin CGC-311.

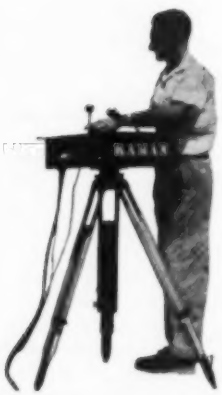
**Century Electronics & Instruments, Inc.**
1333 No. Utica, Tulsa, Oklahoma

# World's First Unmanned 'Copter

The successful maiden flight of Kaman's pilotless helicopter has added a new concept to military strategy. Flown entirely by remote control, the variety of missions possible with these ships is almost limitless. Using the Kaman robot as a flying TV or motion picture camera, complete battlefield surveillance and target marking are available without hazard to personnel. Also possible is the entry of the robot helicopter into contaminated or hazardous areas.

The control station is portable and can be operated from the ground or in air to air operations. Mission equipment such as cameras, weapons, target markers and detonators can be actuated at the control station.

Kaman is proud of this forward step which has been taken in behalf of our National Defense effort.




KAMAN

THE KAMAN AIRCRAFT CORPORATION
Bloomfield, Connecticut

# AIRFRAME ENGINEERS

As leaders in the development and production of rotary wing aircraft, Kaman offers a solid future to a few specially trained airframe engineers who can qualify for the positions listed below. A friendly company, located in colorful Connecticut, Kaman is young in years **and ideas.** You'll find this combination the key to a pleasant, profitable future.

**AIRFRAME DESIGN ENGINEERS**

Responsible for major phases of air frame structural design of a high order of complexity. Minimum of 3-5 years in airframe design required.

**AIRFRAME STRUCTURAL STRESS ANALYSTS**

Must have 3-5 years intensive experience in structural stress analysis of airframe components, such as stressed skin, frames and bulkheads, and allied major fittings. Work requires familiarity with statically indeterminate structures.

**WEIGHTS CONTROL ENGINEERS**

Minimum experience 3-5 years dealing with all aspects of weight control engineering, from preliminary design through the production phase.

**AIRCRAFT ELECTRICAL ENGINEER**

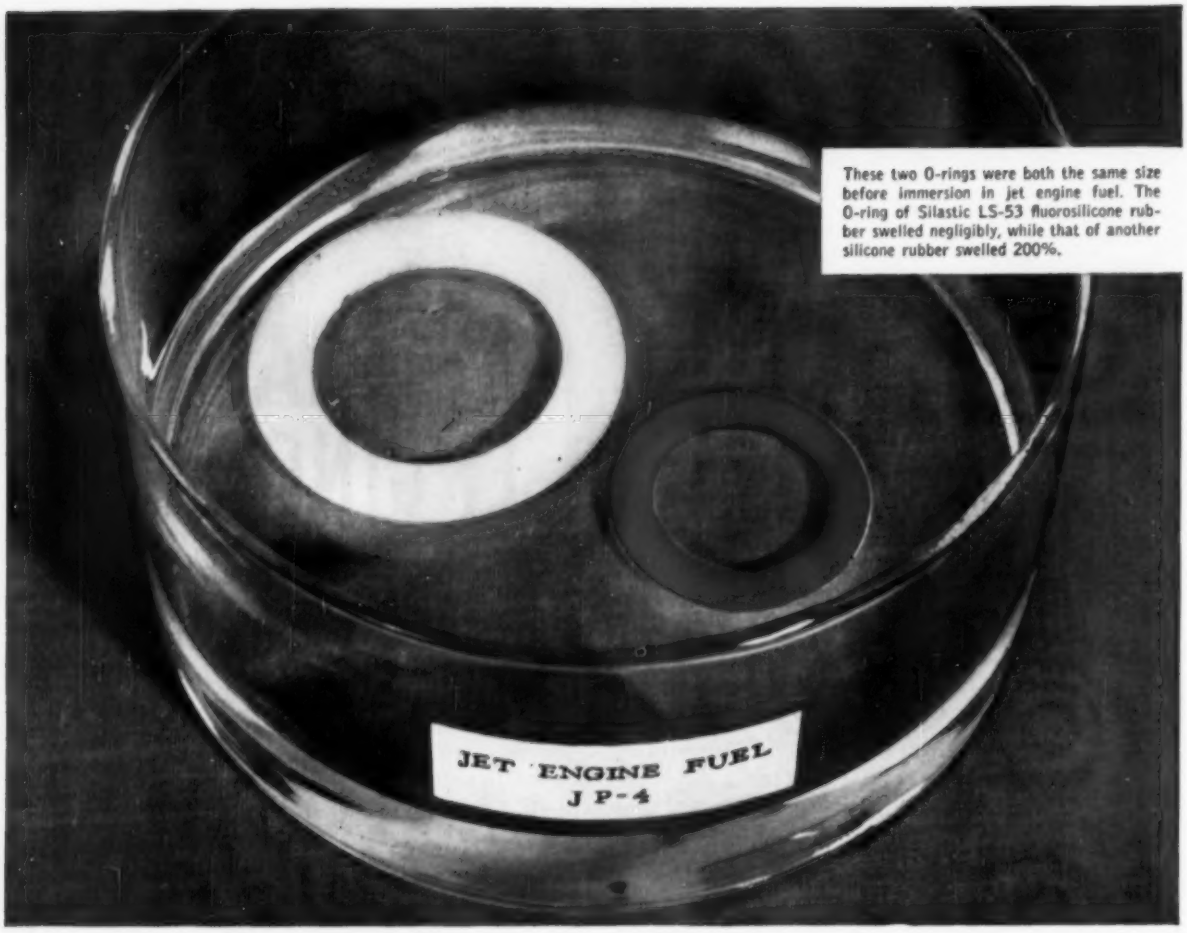
With experience in design of AC and DC power generation and distribution circuits, and in selection and application of associated components.

**AIRCRAFT EQUIPMENT ENGINEER**

Experience required in selection and installation of aircraft furnishings. Heating, ventilating, anti-icing and/or instrument experience desirable.

*If you qualify, rush your resume to:*
*Wm. M. Tynan, Administrative Engineer*
*Kaman Aircraft Corporation*
*71 Old Windsor Road*
*Bloomfield, Conn.*

KAMAN




These two O-rings were both the same size before immersion in jet engine fuel. The O-ring of Silastic LS-53 fluorosilicone rubber swelled negligibly, while that of another silicone rubber swelled 200%.

# SILASTIC
## SILICONE RUBBER
# now resists fuels, oils, solvents

**For resistance to fuels, oils and solvents, specify Silastic LS**

Aircraft and automotive fuels, oils, and solvents won't deteriorate Silastic* LS-53, a new Dow Corning fluorocarbon silicone rubber. Silastic LS-53 has unusual resistance to other organic chemicals as well as silicone fluids. In physical properties, such as low compression set and serviceability at −80 or 500 F, Silastic LS-53 resembles other silicone rubbers. Available from leading rubber companies.

**Get latest data on Silastic. Mail coupon today**

Dow Corning Corporation, Dept. 0922
Midland, Michigan

Please send me latest data on Silastic

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

### Typical Properties of Silastic LS-53
*(cured 24 hours at 300 F)*

| | |
|---|---|
| • Tensile strength, psi | 1000 |
| • Elongation, % | 170 |
| • Compression set, %, 22 hrs @ 300 F | 22 |
| • Brittle Point, °F | −90 |
| • Solvent Resistance, % swelled | |
| ASTM No. 3 Oil, 21 days @ 300 F | 3 |
| Jet Fuel JP4, 15 days @ 250 F | 18 |

*T.M. REG. U.S. PAT. OFF.

**If you consider ALL the properties of a silicone rubber, you'll specify SILASTIC**

first in silicones

**Dow Corning CORPORATION**
MIDLAND, MICHIGAN

## Seminar to Emphasize Collision Prevention

Sessions on proximity warning and painting for maximum visibility, anti-collision lighting, altimeter error and lessons learned from analysis of mid-air collisions will receive the most attention at the annual International Air Safety Seminar at Palo Alto, Calif., Nov. 11-15.

Panel meetings on human engineering, design safety engineering and seat design percepts will also be included, as will vertical flight and intra-company communication with regard to spreading air safety doctrines. On the final day, David Little of American Airlines will discuss progress in all-weather operation; Capt. E. E. Roadley of British Overseas Airways Corp., and A. M. (Tex) Johnson of Boeing will talk on future jet operations, including transition training and pilot selection.

Some 300 air safety experts from the U. S. and abroad are expected to attend the seminar, which will comprise closed sessions for the most part. Flight Safety Foundation, 468 Fourth Ave., New York, N. Y., is sponsoring the seminar.

## Atomic Isotope Tubes Measure in Millionths

Atomic isotope tubes providing highly accurate light sources for measuring to fractions of millionths of an inch are being tested by an industrial firm cooperating with the U. S. Bureau of Standards. Program seeks to develop a practical device for laboratory use to provide absolute measurement to a tenth of a millionth of an inch.

Sheffield Corp., manufacturer of gaging and measurement instruments and systems, has received two Krypton 84 atomic isotope tubes developed by West Germany's bureau of standards (Physikalisch-Technische Bundesanstalt) for use in an interferometer.

## Temco Engineers Fill Science Teacher Gap

**Dallas**—Temco Aircraft Corp. is providing engineers to teach physics to 95 students in four high schools in the Dallas area in an effort to give students a better chance for scientific careers.

Without company help, the schools would not be able to provide physics courses because of a lack of teachers.

Company decided to provide part-time instructors for the four schools so that students with the talent and desire wouldn't be barred from higher education and technical careers because of a lack of physics courses.


the head of the family

The Couch Type 4A relay heads a family of rugged relays — relays that can withstand the extremes of shock, vibration, and acceleration — all because of a unique patented rotary armature design. The 4A design will answer your dry circuit switching problems too. Our Bulletin 132 will tell you more. Write for it today.

IMPORTANT SPECIFICATIONS

Contacts: 4PDT (4 Form C)

Size & weight: $1\frac{3}{32}$" D x $1\frac{1}{2}$" H, 3.2 oz.

Pull-in power: $\frac{1}{2}$ watt

Ambient temperature: -65°C to 125°C

Vibration resistance: 20G, 5 to 2000 cps

Shock resistance: 75G operating, 200G non-operating

Illustrated on the right are some of the many possible mounting variations available.

Couch ORDNANCE INC.

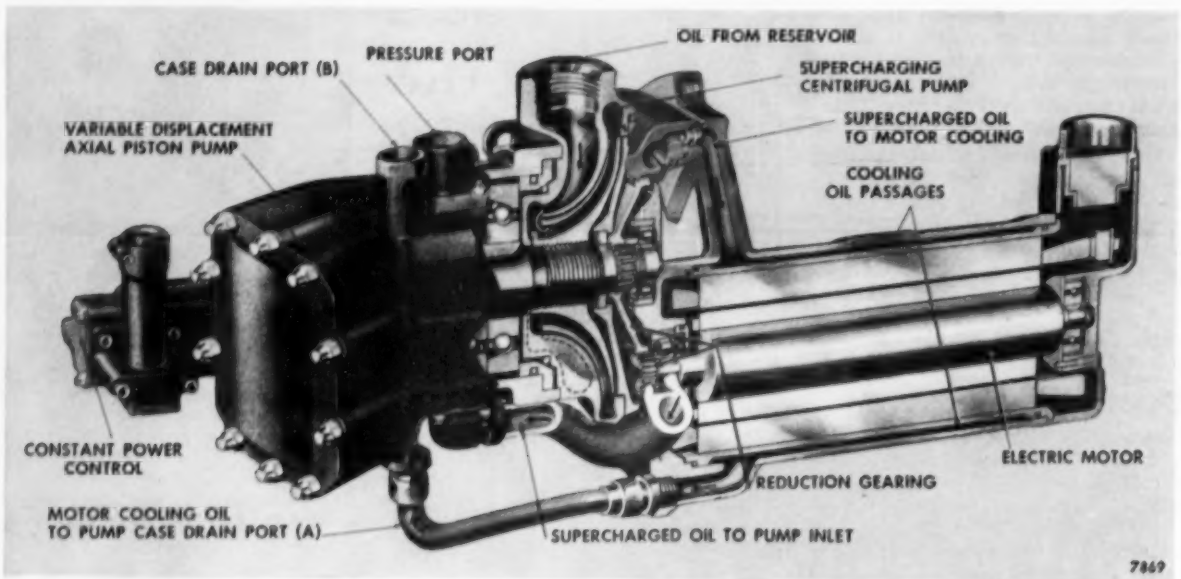
A Subsidiary of S. H. Couch Co., Inc.

3 Arlington Street
North Quincy, Mass.

(Advertisement)

# New Vickers OIL COOLED Motorpump

## For Continuous Duty Applications




### Installed weight approximately 25% less; also offers significant size reduction

The 12 horsepower oil cooled motorpump shown above weighs 31¼ lb and is 20" long overall . . . motor diameter is less than 4". This represents a substantial saving in weight and size over the conventional air cooled motorpump. Also, there is a further saving with the elimination of duct work in the airframe normally required for air cooling the electric motor. The motorpump illustrated *is now in quantity production* for turbine powered transports.

The time-proven Vickers variable displacement piston type pump, which is an integral part of this "package", delivers up to 8 gpm at 2250 psi, reduces to 6 gpm at 2950 psi and zero flow at 3000 psi. These flow and pressure combinations (8 to 6 gpm range) provide constant horsepower for a variety of flight operating requirements. It is designed for *2000-hour* service.

A centrifugal boost pump is located between the pump and the 400 cycle, 200 v electric motor; in addition to supercharging the pump, it circulates oil through the double-walled motor casing. Cooling oil from the motor jacket is discharged into one case drain port (A) . . . then out port (B) to a heat sink. At full pump flow, the impeller provides 2 gpm to the motor casing.

The 12 horsepower unit described above is typical of the Vickers motor and pump combinations now available to the aircraft industry as "packaged power" for continuous duty applications. Remarkable records for reliability in both military and airline service have been established by Vickers designed motorpumps.

#### Higher Overall Efficiency

Overall motorpump efficiency (hydraulic power output to electric current input) is 75%. This is possible only because Vickers Piston Pumps have an overall efficiency of 92%. The more efficient pump means the use of a smaller, lighter electric motor, minimum heat transfer to the hydraulic circuit, and less current drain.

#### Heat Rejection Control

The oil cooled motor design offers a definite advantage in that heat dissipated (140 Btu per minute, maximum) can be conveyed readily to a remotely located heat sink. This is one reason why optimum performance for a given weight and size is more readily achieved in a liquid cooled unit.

#### High Altitude Operation

Motor operation is not affected by low air density since it is not dependent upon air cooling. Inclusion of centrifugal boost pump prevents piston pump cavitation above 30,000 ft, even though reservoir is vented to atmosphere.

#### Constant Power Control

The constant horsepower control shown on the above unit is optional, depending on the application. The control maintains constant 3000 psi pressure as flow increases until the electric motor is loaded to its maximum horsepower. Additional flow is then available at reduced pressure to maintain the same horsepower load on the motor. This type of control is particularly advantageous for low force, high capacity (flow) and high force, low capacity applications while staying within the limits of recommended electric motor load ratings.

#### Packaged Unit

The axial piston pump, centrifugal boost pump, reduction gear and electric motor are all integrated into an exceptionally compact and high-performance package. This concept also permits a high degree of design flexibility to meet individual requirements.

#### Sound Insulated

Because air ducts are not needed to dissipate motor heat, the oil cooled motorpump can be sealed in a compartment and effectively sound insulated.

#### Additional Advantages

Low frictional starting torque characteristics of the 12 horsepower unit permit acceleration to maximum speed in less than 200 milliseconds. The electric motor meets the military specifications for explosion-proof operation.

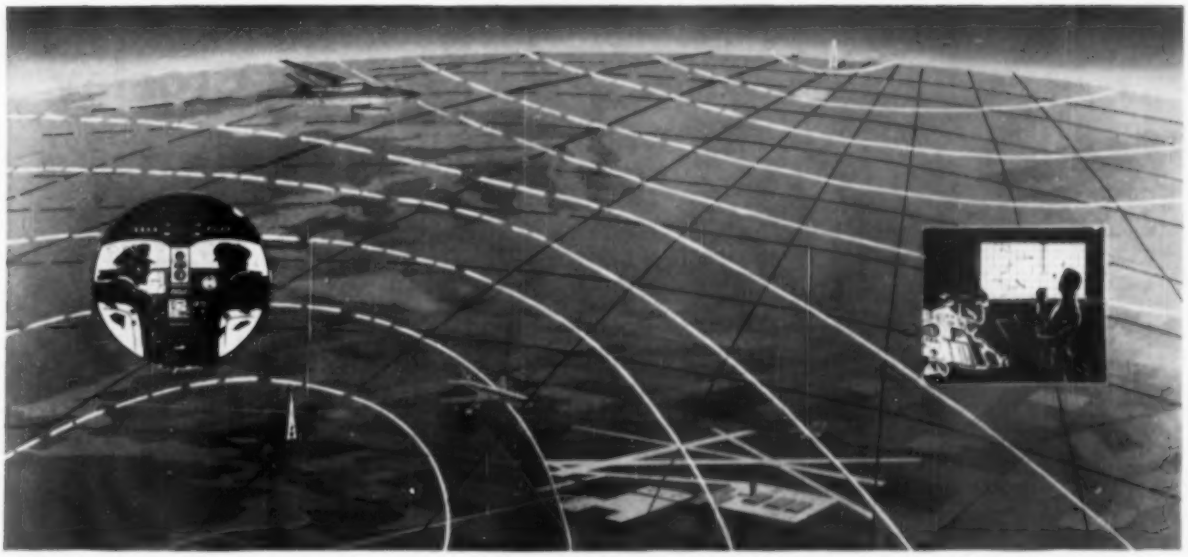
For further information contact the nearest office listed below.

**VICKERS INCORPORATED**
DIVISION OF SPERRY RAND CORPORATION

Aero Hydraulics Division
Engineering, Sales and Service Offices:

| Administrative & Engineering Center | 3201 Lomita Blvd. |
|---|---|
| Detroit 32, Michigan | P.O. Box 2003 |
| | Torrance, California |

*District Sales and Service Offices:* Albertson, Long Island, N. Y., 882 Willis Ave. • Arlington, Texas, P. O. Box 213 Seattle 4, Washington, 623 8th Ave. South • Washington 5, D.C., 624-7 Wyatt Bldg. • *Additional Service facilities:* Miami Springs, Florida, 641 De Soto Drive
TELEGRAMS: Vickers WUX Detroit • TELETYPE: "ROY" 1149
CABLE: Videt
OVERSEAS REPRESENTATIVE: The Sperry Gyroscope Co., Ltd. Great West Road, Brentford, Middx., England



**RADIO WEB,** hyperbolic navigation system developed in France, may also provide traffic control, collision avoidance and selective calling features. System has been presented by France at current ICAO meeting.

# French Radio Web Enters Navaid Race

By James A. Fusca

**Montreal, Canada**—Area coverage navigation system that not only tells the pilot where he is but can also display to him positions of nearby aircraft and, additionally, display on the ground for air traffic controllers the positions of aircraft in their control area, has been presented here.

Called Radio Web, system has been offered for consideration as a standard international navigation aid by French delegation to sixth Communications Division meeting of the International Civil Aviation Organization. Stavid Engineering, Inc., Plainfield, N. J., licensee for Radio Web in U. S. and Canada, is at present actively seeking U. S. military and civil support for the system.

## Test System

Radio Web has been developed by Col. Pierre Gaudilliere, director of the Societé Francaise de Telecommunications, under a contract between the French government and the firm Radio A. I. R. An experimental net of four transmitters has been set up near Paris and a prototype airborne unit flight tested. Now being assembled are a ground traffic control installation, and proximity warning and chart display devices for airborne installation.

The basic techniques of Radio Web can be used over a wide range of operating frequencies, from very-low frequency (VLF) to ultra-high frequency (UHF). Present experimental Radio Web in France operates in the medium frequency band, around 2,000 kc.

For medium- and long-range service, the frequency probably will be in the 90-110 kc. band, the same used for Navarho and Loran-C (Cytac).

Fifteen ground stations, operating in the 90-110 kc. band, could provide complete navigation coverage of the U. S. and provide an accuracy of one-half mile, according to Stavid engineers. (See sketch, below.)

Distance between stations in this arrangement is 600 mi. and the required power is estimated at 100 kw. For transoceanic operation, a distance of 2,000 mi. between stations along the route would give an estimated accuracy of 5 mi.

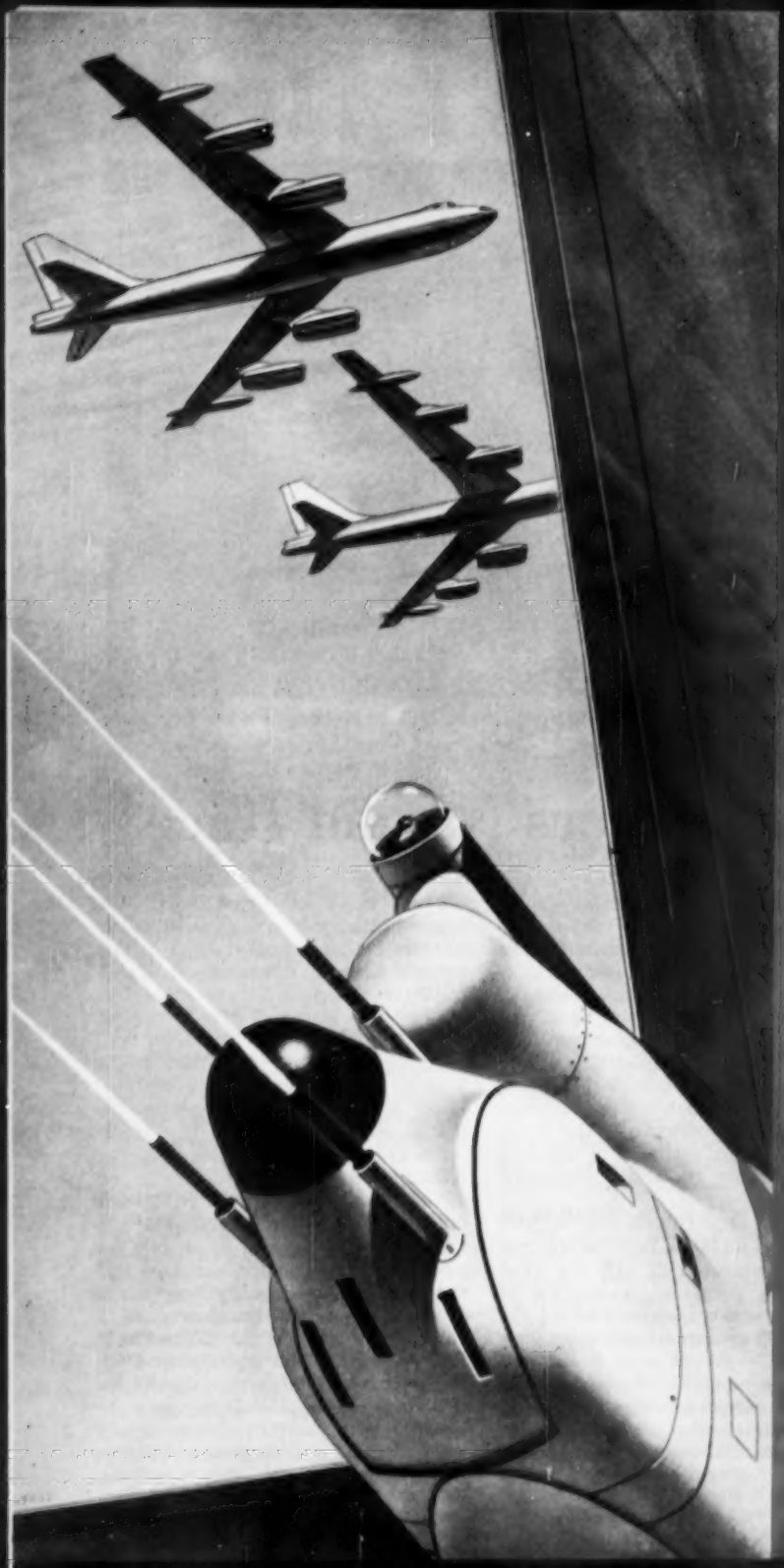
Although no airborne equipment has been designed yet for commercial sales, Stavid estimates that a manually operated private flyer-type receiver, providing only position-coordinate information, can be built for less than $1,000 and will weigh less than 10 lbs. For automatic airline-type equipment which includes the additional features of the system, cost is estimated at about $5,000 and weight at about 60 lbs.

**FIFTEEN** station coverage of U. S. by Radio Web.

## Information Available

Stavid engineers state that Radio Web is unique among presently proposed systems for air navigation in that it is the only system that is capable of providing simultaneously the following types of information:

- **Navigation.** The airborne equipment presents to the pilot a continous and unambiguous indication of aircraft position. Depending upon size, cost and complexity of airborne equipment, airplane position can be shown on a chart display such as the Decca Flight Log, as bearing and distance to destination; or in position coordinates on digital counters. The latter must be referred to a chart to obtain aircraft position. Radio Web enables pilot to fly any selected route and is not adversely affected by increasing density of aircraft in the area.
- **Traffic Control.** System provides a radar-like display for the ground traffic controller that shows him position of all aircraft in his control area equipped with a transponder beacon, and permits him to communicate selectively with any one of the aircraft.
- **Collision Avoidance.** All nearby aircraft equipped with transponders can



*Avco today*

# Avco's Crosley builds the "trigger finger" for SAC

Reliable protection is a *must* for Boeing's giant B-52, operational weapon of the Strategic Air Command. A Crosley-manufactured MD-9 fire control system—with dual radar and multi-weapon turret—provides deadly and almost completely automatic protection for the B-52.

This newest "stinger" is one of a long list of modern bomber defense systems produced by Crosley. And, looking to the future, Crosley scientists are constantly developing still finer protection for the aircraft of tomorrow.

**THIS IS AVCO**

Avco today is a diversified organization whose products include aircraft power plants and structures, electronics for defense and industry, and specialized home and farm equipment. Avco's divisions and subsidiaries are:

Crosley—electronics and aircraft structures . . . American Kitchens . . . Lycoming—reciprocating engines and gas turbines . . . New Idea and Ezee Flow—specialized farm equipment . . . Research and Advanced Development . . . Crosley Broadcasting Corporation . . . Moffats, Ltd.—commercial gas and heating equipment.

*Scientists interested in unusual opportunities for advancement can grow with Avco.*

**Avco makes things better for America . . .**

**Avco**

Avco Manufacturing Corporation,
420 Lexington Avenue, New York, N. Y.

be shown on a radar-like display in the cockpit. Display shows pilot's own aircraft at the center and relative position, direction and speed of nearby aircraft. Range of the display is limited to area and altitude required for collision avoidance.

### System Fundamentals

Signals from any pair of Radio Web ground transmitters tend to cancel one another everywhere they mix except along one line where their signals are in phase and add together. This line of equal phase is called "isophase" and is a distinguishing feature of Radio Web.

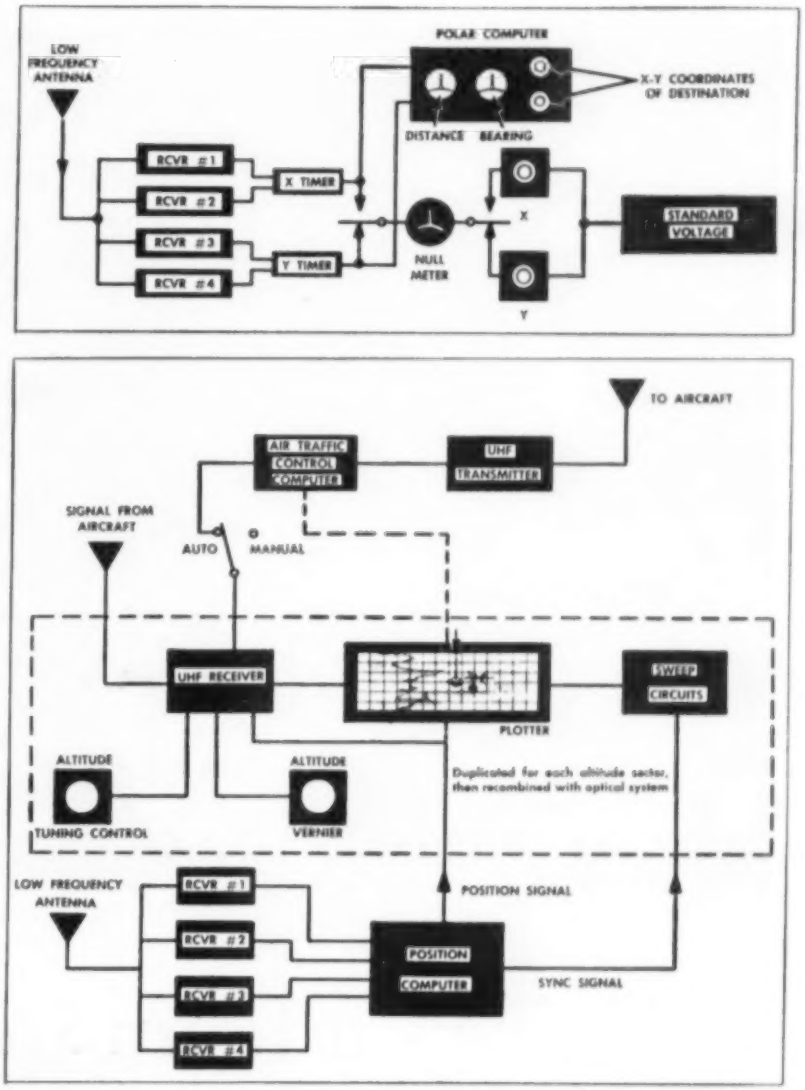
This isophase line moves from one station to the other at a relatively slow speed, about once every second, then repeats the cycle.

Heart of a Radio Web ground installation is a group of four transmitters, each located in the corner of a square or rectangle which surrounds the area to be covered.

Each pair of these four stations produces a traveling isophase line. One moves east to west, another west to east, a third north to south and a fourth south to north.

By measuring the difference in arrival times between the two isophase lines traveling in the east-west direction, the airborne Radio Web receiver establishes aircraft position in this coordinate. Similar time-interval measurements in the north-south isophase arrival times make it possible to establish airplane position in this coordinate. The two in combination establish airplane position.

In aircraft equipped with transponders, one of the four isophase lines automatically triggers the transponder as it passes the airplane. The ground controller's Radio Web display, resembling a radar PPI, is electronically controlled so that the aircraft's transponder beacon signal produces a target blip at the aircraft's position.




**RADIO WEB** airborne equipment varies from the simple unit for the private pilot (top) to the airline version (bottom).

### Controller Calls Aircraft

Another feature of the projected ground control installation is a means for the controller to be able to call selectively any aircraft in his area. The controller would do this by positioning a pointer over the target blip on his display of the aircraft to be called. This automatically initiates a calling signal so that it arrives at the aircraft at the same instant as the isophase. The coincidence of the selective calling signal and the isophase automatically "opens" the aircraft's communication receiver to accept the ground controller's message. Message is not received by other aircraft in the area.

Any station in the basic group of four can also serve as one station of an adjoining group, simplifying the problem of expanding the coverage area. Also, ground control centers for adjoining areas can be located together in a common facility to reduce operating costs.

At the present time Stavid plans three different types of airborne equipment, varying in complexity from a simple, light unit for the private pilot that would provide navigation information only, to an airline version which would incorporate all features of the system. Stavid has pointed out that this expansion is by modular units to reduce cost and increase system flexibility. (See sketch above.)

The basic unit consists of a four-channel receiver which drives a series of synchronous detectors. These in turn provide the inputs to two simple timing devices which measure the time intervals between receipt of signals (the four isophases) in the four channels. The four channels are required because each ground station transmits on a different frequency. In this simplest unit, the pilot adjusts knobs to bring an indicator needle to a null position. The outputs of the two timers provide position information in rectilinear coordinates. This information can, if desired, be fed to a simple computer which determines distance and bearing to destination.

### Advanced Version

In a more complex version of the equipment, the rectilinear coordinates are presented automatically in digital form and the aircraft's past course and present position also appear on a chart display device. The addition of the airborne transponder beacon results in aircraft display at the ground traffic control center.

The airline version of the equipment

R.W.F. (Big Bob) Schmidt, Manager, Tucson Airport Authority

# There's a team in Tucson worth knowing about!

*Big Bob Schmidt and Shell, working together at Tucson, Arizona, Airport have increased aviation fuel sales fivefold since 1948!*

Seems everything's big at the Tucson Airport—Big Bob, big sales . . . and big plans that are underway to extend the 12,000-foot runway to 15,000 feet, making it the longest in the world!

"One of the things that attracted us to Shell," says Bob, "was the company's reputation for helping dealers grow. We knew there must be good reasons for it. We soon found out. Giving engineering and other specialized assistance to help dealers build for the future is one secret of Shell's position as an aviation supplier.

"For example, when we needed more bulk space, Shell engineers designed and supervised the construction of storage facilities.

What's more, Shell's technical representative is always here when we need him, making our job of keeping our customers satisfied a lot easier."

And at Tucson, customers *are* satisfied. Pilots know that a Tucson stopover means a lot more than sunny weather. Big Bob gets them in and out again—fast! He delivers the kind of service they need for on-schedule take-offs every time.

Responsibilities fall on Bob Schmidt when he's *away* from the airport too. Bob is president of the National Foundation for Asthmatic Children, president of the American Association of Airport Executives, a director of the Tucson Metropolitan YMCA, and chairman of the Y's Southside Branch.

Shell is constantly on the watch for men who can build careers to match that of Bob Schmidt.

Corporate plane taxies past control tower on way to spacious parking ramps. New operations' building and ten-story tower are under construction.

Big Bob and Shell representative "Nebby" Nebeker stand near bulk storage tanks discussing plans for still further expansion of airport facilities.

Speedy turnabout service is provided for huge airliners landing at Tucson. Efficiency results in on-time take-offs.

**It pays to be a Shell Aviation Dealer**

***—and the Shell office nearest you will be glad to show you why***

SHELL

To **engineers** who want to straighten

out the curves in their careers...

**DOUGLAS TEAMWORK HELPS TO RELIEVE ENGINEERS OF BURDENSOME PROJECT DETAILS!**

There are no "dead end" jobs at Douglas. As part of a crack engineering team, you'll be encouraged to use your full talents. Important assignments will give you the opportunity for greater accomplishments and the kind of future you want for you and your family. Wherever you choose to locate — in California or across the nation — Douglas offers many career opportunities including...

**TOP ASSIGNMENTS FOR STRESS ANALYSTS!**

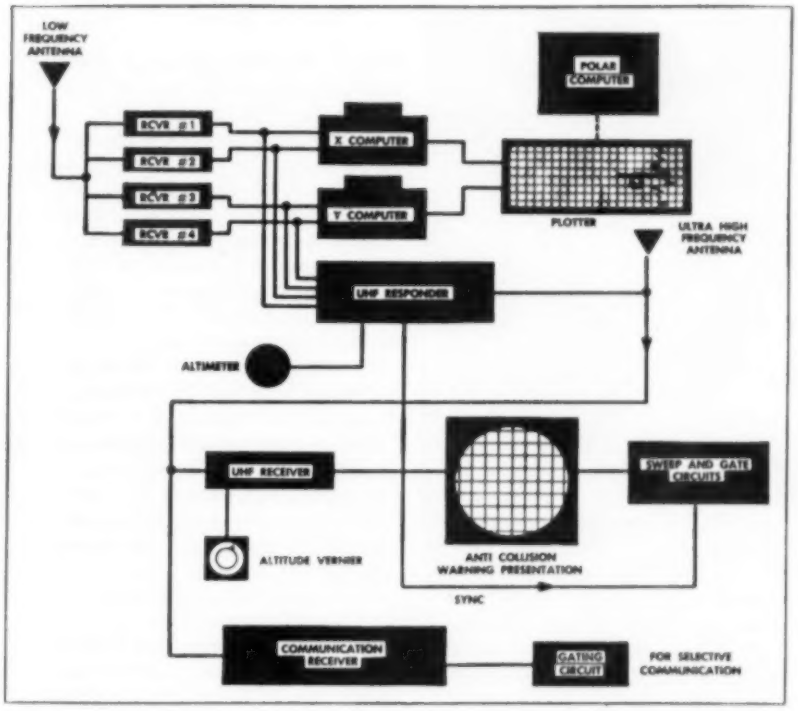
Aeronautical, Civil and Mechanical Engineers work on structural strength assignments from design stages through static, dynamic and wind tunnel testing.

For important career opportunities in your field, write:

C. C. LaVENE
DOUGLAS AIRCRAFT COMPANY, BOX 620-M
SANTA MONICA, CALIFORNIA

Go further with **DOUGLAS**

**FIRST IN AVIATION**




**PROPOSED** ground control unit for Radio Web.

would include, in addition to the above features, the proximity warning display and a gating circuit unit to open the aircraft's communications receiver when signaled by the ground controller.

Transponder beacons are all to be equipped with sealed and calibrated aneroid barometers for transmission of altitude information. With all barometers calibrated to the same standard, relative altitude between aircraft can be determined even though absolute altitude cannot (because of standard changes in barometric pressure). Altitude information would be transmitted either by changing the pulse width of the transponder beacon's reply or as a slight shift in beacon frequency.

### Pilot Steps

A pilot entering a particular Radio Web coverage area or traffic control area would first tune each of the four channels of his receiver to one of the ground stations, then set the transponder beacon to an assigned frequency. (See sketch above.)

The ground controller assigned to a particular altitude section will have set his receiver to display only those aircraft whose transponder beacon replies place them in his section. As mentioned, he can selectively call any aircraft on his display by moving a pointer to point to the target blip of the aircraft on his display.

In the future it will be possible to attach a computer to integrate the position information of all aircraft in the area to obtain course information and to determine whether any aircraft are on collision courses, Stavid believes.

### Principles of Operation

Each of the four transmitters of a basic Radio Web network transmits on a different carrier frequency, modulated at different but very closely spaced audio frequencies.

If an observer standing on a baseline connecting two transmitters were able to physically see the isophase, it would appear to start at one transmitter, move along the baseline until it reaches the other, then repeat the cycle—always sweeping in the same direction. The isophase moves from one transmitter to the other at a steady rate, called the scanning speed, that depends on the difference in modulation frequencies between the two stations. The time internal between passages of the isophase is the scanning period.

### Ambiguity Guard

The modulation frequencies are so chosen that there is only a single isophase line at any instant between two adjoining stations, in order to prevent ambiguity in the system.

The signals transmitted from each station travel outward in a circular direction. Therefore, the isophase does not extend to either side of the baseline as a straight line but as a curve (hyper-


...almost weightless
(3 oz.)

Giannini

TRUE-TRACE
MACHINE TOOL CONTROLS
*Send for new 24 page catalogue*
*Greater production and increased profits* thru 1, 2 and 3 slide control hydraulic tracers and numerical controls.
TRUE-TRACE SALES CORP.
El Monte 31, Calif

## Chop weight, get thinner sections with Alcoa high-strength castings

Reduced weight and higher strength are now casting realities. Thinner sections, lighter parts are now possible. Castings can be stressed to new limits. Alcoa's new high-strength process guarantees you high properties.

Formerly, the properties of a casting were based on separately cast test bars. In design and application, a casting factor had to be applied to reduce these properties. With Alcoa's new high-strength casting method, properties are based on bars cut right from the casting itself. No reducing necessary. And, best of all, the guaranteed properties are in *all* the castings in the run . . . consistent, guaranteed, high properties in castings for aircraft structural parts.

New carefully controlled foundry practice and improved alloys are the developments responsible. The alloys are A356 and C355. These are the same composition and meet specifications for familiar alloys 356 and 355, with one difference: Impurities are controlled to a new minimum. Iron content, for example, is held to 0.2% in the improved alloys. Such seemingly minor changes make a whale of a difference.

Equally careful control in all steps of the foundry process, plus several new Alcoa developments in aluminum foundry techniques, is also vital in making these high-strength castings.

High-strength castings can be made in sand or plaster molds . . . sometimes in permanent molds. Alcoa's standard guarantee of properties for alloy A356-T61 is 38,000 psi tensile, 28,000 psi yield, and 5% elongation. Occasionally, because of complex shapes and designs, high strength can be furnished only in certain areas of the casting. But, by working closely with the designer, Alcoa can usually put the high strength right where it's needed.

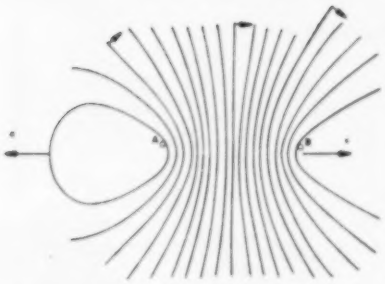
Your Alcoa sales engineer has the facts on this new process. Let him work with you in obtaining castings with high properties—properties that don't have to be reduced in application. Aluminum Company of America, 1800K Alcoa Building, Pittsburgh 19, Pennsylvania.

*Important missile structural castings for Douglas. Alcoa's high-strength casting process and alloy A356-T61 give them some of the highest properties ever cast. Here are the properties obtained on test bars cut from the castings.*

| | *Tensile, ksi* | *Yield, ksi* | *Elongation, %* |
|---|---|---|---|
| *Front Casting* | | | |
| Average | 43.2 | 32.1 | 9.7 |
| Maximum | 44.4 | 34.1 | 11.0 |
| Minimum | 40.5 | 30.3 | 6.7 |
| Tests—8 from 8 production runs | | | |
| *Back Casting* | | | |
| Average | 43.1 | 34.3 | 5.5 |
| Maximum | 47.1 | 36.9 | 9.0 |
| Minimum | 40.2 | 32.2 | 4.0 |
| Tests—22 from 12 production runs | | | |
| **Minimum Required** | **40.0** | **30.0** | **3.0** |


NEW! "ALCOA THEATRE"
EXCITING ADVENTURE
ALTERNATE MONDAY EVENINGS

*Your Guide to the Best in Aluminum Value*



**MOVEMENT** of the isophases.

bola) which changes its form in proportion to the distance the two signals have traveled. (See sketch above.)

### Position Measuring

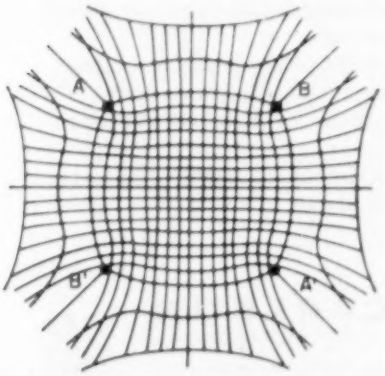
The four stations of the basic Radio Web system are set up with each transmitter synchronized with the one diagonally opposite, so that the four isophases sweeping the coverage area are synchronous. For example, an isophase moving from west to east would start and finish at the same time as one moving from east to west.

The airborne receiver determines the position of an aircraft by measuring the time interval between the arrival of the two pairs of isophases. For example: if all four isophases were received at the same time, the aircraft would be in the exact center of the coverage area. The position lines obtained in this way form a fairly regular grid which can be overprinted on a map or used with a slightly distorted map. (See sketch below.)

### Position Determining Method

In the basic Radio Web system described previously, the isophase moved steadily from one station to the other. For the position determining method used with the ground control display unit, the Radio Web stations do not transmit continuously but instead transmit pulses. Operation of the airborne equipment is not affected.

When the transmitters are pulsed




**SQUARE** transmitter pattern.

There's more PULL
built in
Sensenich Propellers
New
FIXED PITCH METAL
CAA approved up to 165 hp.
FIXED PITCH WOOD
CAA approved up to 225 hp.
TEST CLUBS
up to 3000 hp.
Get all the facts...
write for Bulletins and Price Lists.
Dept. A, Sensenich Corp., Lancaster, Pa.
Sensenich PROP SHOP... Certified Repair Station for all makes fixed pitch metal or wood propellers ... Sensenich, Beech and Hartzell controllables. Magnaflux, etching, anodizing and plating service available. Service Hangar on Lancaster Municipal Airport. Approved Propeller Repair Station 3528, Unlimited Class 1 and 2 ratings.
Serving the Aircraft Industry
for a Quarter of a Century
AIRCRAFT
SENSENICH
PROPELLERS

HUNTER

# HEATING SYSTEMS

## FOR MILITARY APPLICATIONS

Hunter heating systems are used for a wide variety of military applications. They are standard heating and winterization equipment for many types of mobile shelters, military engines, generator sets, etc. and are designed to conform to military multi-fuel requirements.

### HUNTER SPACE HEATERS

for mobile or portable military shelters, for radio, radar and guided missile control and maintenance installations.

### HUNTER ENGINE HEATERS

for starting internal combustion engines at sub-zero temperatures, for trucks, generator sets, air compressors, etc.

### HUNTER SPX TORCHES

for a wide range of applications at sub-zero temperatures. An unpowered open flame burner capable of being lighted with a match and operated on conventional fuels at temperatures down to 90° below zero. Capacity range—from 15,000 to 200,000 BTU.

**Write for Folder FB-N156 "Hunter Development and Production Facilities"**

**HUNTER** Manufacturing Co.
30521 Aurora Rd., Solon, Ohio
Heating and Refrigeration Systems

# 3-minute check-out for jets

Our system for testing guided missiles before launching can be applied with equal practicality to checking the standby readiness of jets.

With an adaptation of test equipment we have already produced, *one man* will be able to check out a jet in *three minutes.* This application to jets is now only a matter of cooperative development.

The system will be compact and mobile and will utilize the latest digital and analog control system techniques. Test sequence and acceptance limits will all be programmed in advance. An "umbilical" cord will be used for plug-in connection to an associated output jack on the aircraft.

The system will automatically perform the tests, evaluate the responses, and—in three minutes—either check out the plane for flight, or call for replacement equipment.

We would welcome the opportunity to discuss application of these techniques to any similar testing problem.

S-C

**STROMBERG-CARLSON**

A DIVISION OF GENERAL DYNAMICS CORPORATION

General Offices and Factories at Rochester, N. Y.—West Coast plants at San Diego and Los Angeles, Calif.

GD

synchronously, the isophase moves in small steps or jumps. By proper timing of the pulses, these steps of the isophase do not overlap but are close enough together to prevent holes in the coverage.

Because the two signals that form the isophase meet first on the baseline within a very small area which travels away from the baseline very rapidly as the signal wavefronts advance, a scanning effect is obtained. When a beacon signal is received at the ground control unit, position of the aircraft is determined: first, by how many steps along the baseline the isophase has had time to take and, second, the distance along the curve (hyperbola) that the scanning spot has traveled in the remaining time. Because the time between steps of the isophase is longer than the scanning time of the spot, the two components can be added to give position.

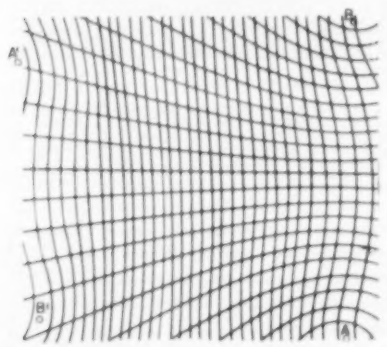
**Position Indication**

The Radio Web PPI at the ground control station is electronically scanned in synchronism with the stepping of the isophase and scanning of the spot so that the time of arrival of transponder reply gives direct indication of give position. (See sketch below.)

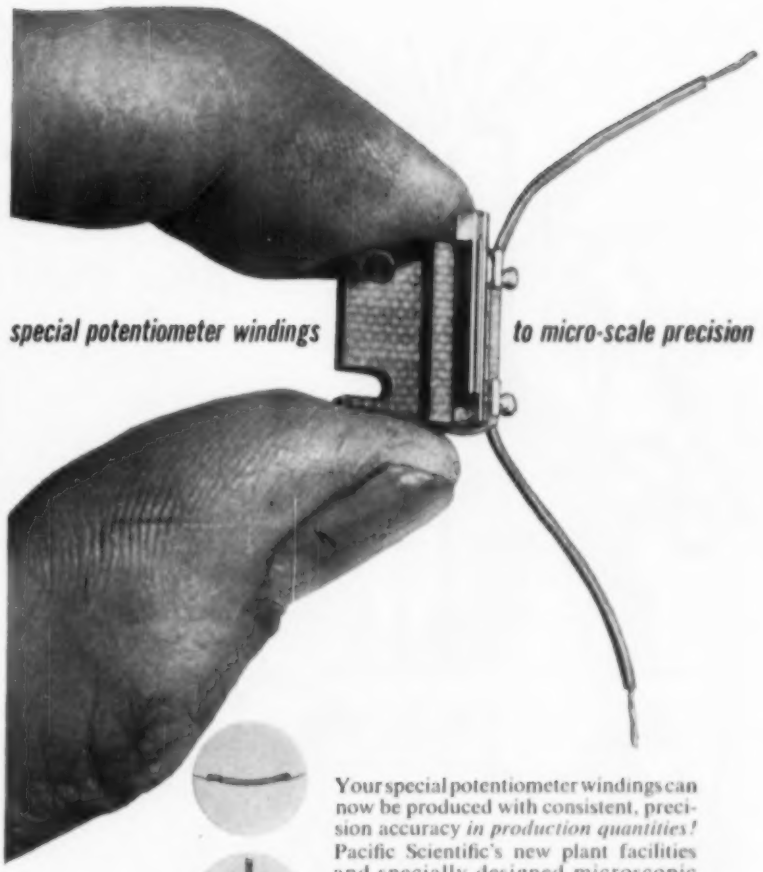
One possible method of collision avoidance is to transmit the ground display to one aircraft, informing it ot the position and course of nearby aircraft. An alternative is to use an airborne cockpit display, similar to that employed on the ground, which is directly operated by transponder replies from nearby aircraft.

The experimental Radio Web network of four stations has been set up by Col. Gaudilliere under a contract awarded by the French government. The transmitters are located in the form of a square with sides about 60 mi. in length.

The experimental stations have a rated power of 100 watts, operate in pairs on carrier frequencies between 1,679 and 1,971 kc. Transmitter A




**SPOT** Scanning Pattern.

*special potentiometer windings* *to micro-scale precision*

Your special potentiometer windings can now be produced with consistent, precision accuracy *in production quantities!* Pacific Scientific's new plant facilities and specially designed microscopic winding equipment can now provide extremely close linearity tolerances on your special designs whether standard or sub-miniature, and in unusual configurations. Elements are wound to your own specifications on glass, Formvar-covered copper or aluminum mandrels, and X-Y recorder inspection assures uniformity of quality.

Pacific's engineering department can also help solve your special problems . . . and complete environmental facilities are available to test to the most rigid military specifications.

Call or write Pacific for engineering assistance on your special potentiometer problems – today!

***complete potentiometers***

Pacific also designs and builds complete potentiometers – both rotary and linear motion – to suit your requirements.

SPECIAL MICRO-WINDING EQUIPMENT FOR CONSISTENT ACCURACY

Pacific

***PACIFIC SCIENTIFIC COMPANY***

P.O. Box 22019, Los Angeles 22, California
San Francisco • Seattle • Arlington, Texas • San Diego
REPRESENTATIVES - Eastern U.S.: Aero Engineering Company • Canada: Garrett Manufacturing Corp.

*How to make the most of your engineering career*

ONE OF A SERIES

# *go where engineers use new materials, new methods*

One of the best ways to get a head start on the future is to gain *early* experience in the use of revolutionary new materials, new alloys, new fuels, new processes.

Boeing, by the very nature of its pioneering work, is among the first companies in the world to work with the newest materials—with metals, for instance, able to withstand the sudden loads and extreme temperatures encountered in missile operations and supersonic flight.

You could speed up *your* engineering progress by getting this kind of ground-floor experience—at Boeing. You'll find the work intensely interesting, and you'll be gaining experience that will be increasingly valuable to you in the years to come.

If you're looking to the future, get in touch with Boeing, where you'd enjoy many career advantages, including assignments in such years-ahead fields as jet-powered airliners, advanced guided missile weapon systems, supersonic flight and inertial and electronic guidance.

Boeing has openings, now, for scientists, and for engineers of ALL categories.

**BOEING**

Aviation leadership since 1916

*Make the most of your engineering career. Fill in the coupon and mail it—today!*

JOHN C. SANDERS, Staff Engineer, Personnel Administrator — Boeing Airplane Co., Dept. C-68, Seattle 24, Wash.

R. J. B. HOFFMAN, Chief of Engineering Personnel, Boeing Airplane Co., Dept. C-68, Wichita 1, Kansas

*Mail this coupon to the address above from which you desire further information about the advantages of a career with Boeing.*

Name_____

School(s)_____ Year(s)____ Degree(s)_____

Address_____

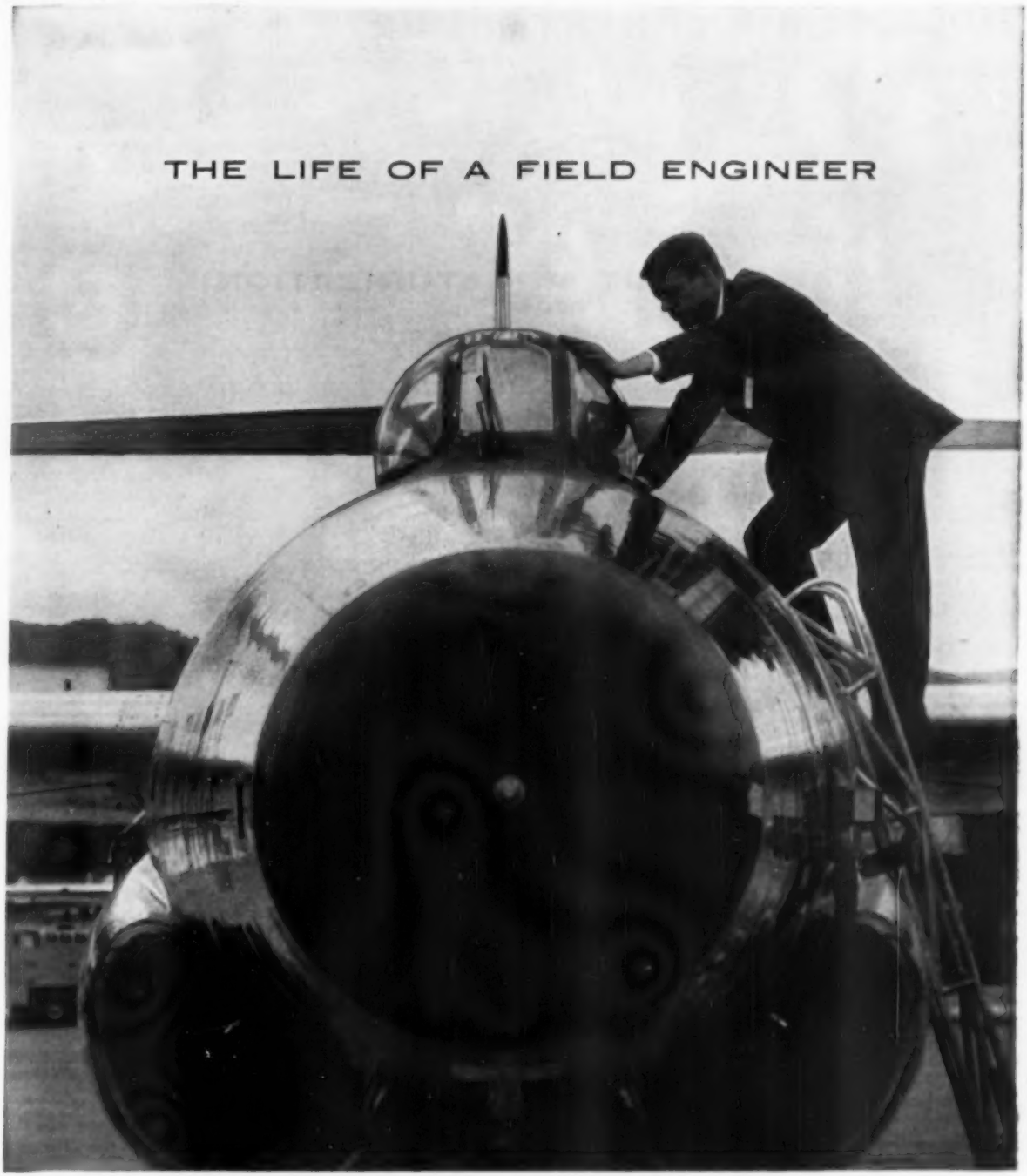
City_____ Zone____ State_____

Telephone Number_____

Soc. Sec. No._____

Life of a Field Engineer, number 2 of a series

# THE LIFE OF A FIELD ENGINEER



Bob Martin, a Hughes Field Engineer assigned to an Air Force Base in California, is responsible for the maximum field performance of Hughes electronics armament and guided missile systems.

Working with complete systems, he learns how each component contributes to the working total. He is given the opportunity to work with electronics systems right where they prove themselves . . . in actual use.

The background and experience gained by such activities provides Hughes Field Engineers with an over-all systems knowledge which is unsurpassed. This training assures them an unlimited future in the field of advanced electronics.

**IF YOU ARE AN ENGINEER OR PHYSICIST** interested in this stimulating and rewarding type of work, send a brief outline of your experience to the address below.

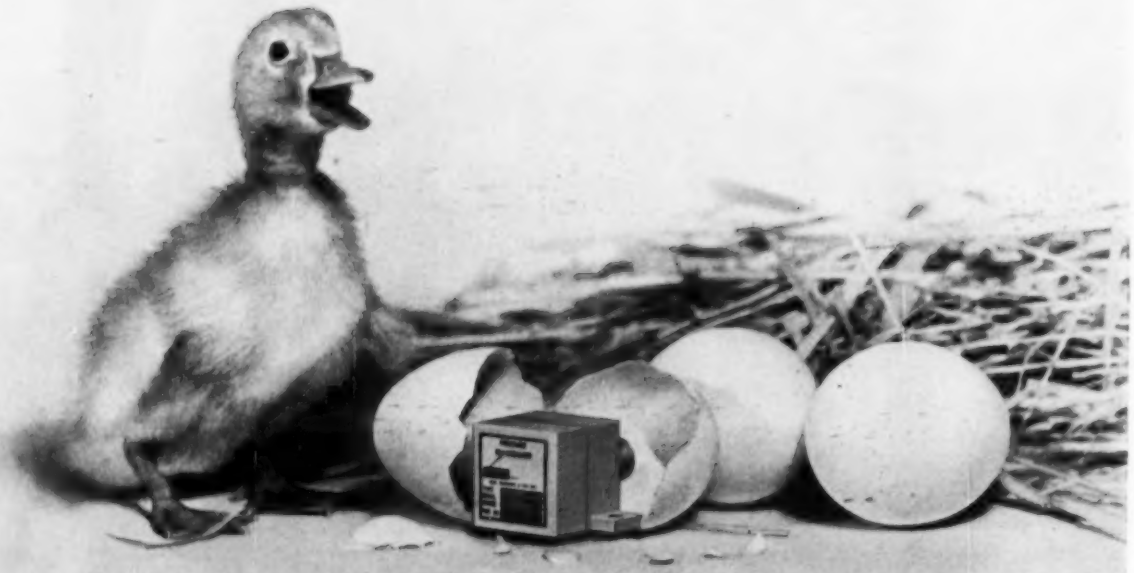
**HUGHES**

*The West's leader in advanced electronics*

**RESEARCH & DEVELOPMENT LABORATORIES** *Scientific Staff Relations, Hughes Aircraft Co., Culver City, California*

## TALK ABOUT MINIATURIZATION!

*...Giannini has really hatched one this time.*



almost spaceless... almost weightless

**THE "ONE CUBIC INCH" PRESSURE TRANSDUCER** —so small that 93 instruments won't quite cover this ad—packs king-sized performance in its 1"/side case.

Developed for the Vanguard Earth Satellite, this potentiometer output transducer provides a high level output proportional to absolute, differential or gage pressures to 50 psi. Resolution is better than 300 wires (0.33%) and weight is *less* than 3 oz.

*For full details, please write for Data Sheet No. 451218, the "Cubic-Inch" Pressure Transducer.*

Giannini

CHICAGO, ILL., 8 South Michigan Ave.
NEW YORK 1, N.Y., Empire State Bldg.
PASADENA, CALIF., 918 East Green St.

G. M. GIANNINI & CO., INC. • 918 EAST GREEN STREET • PASADENA, CALIFORNIA

(located at Meaux) is square-wave modulated (pulsed) at a frequency of 384 cps. and transmitter B (at Montargis) at 385 cps. Modulation frequencies may be obtained alternatively with continuously oscillating tuning forks or crystal oscillators.

Transmitter A′ (Chateaudun) is modulated by a local oscillator locked on the frequency of transmitter A, while transmitter B′ (St. André de l'Eure) is modulated by a local oscillator locked on the signal from transmitter B.

Modulation frequencies of 384 and 385 cps. were selected to provide lane widths (measured along the baseline) of one kilometer (0.6 mi.) and a total scanning period of one second. The four transmitters generate four isophases which travel at a speed (along the baseline) of 390 km./sec.

One type of indicator for use with the airborne receiver is a dual electronic counter fed by a crystal stabilized 1,000 cps. oscillator. The east-west coordinate then is measured as the number of milliseconds between the passage of one pair of isophases and the north-south coordinate by the number of milliseconds between the passage of the other pair of isophases. These coordinates are then displayed on two counter dials which may be installed on the instrument panel.

A second type of indicator measures directly the time interval between the pulses of the two transmitters at 384 cps. and the interval between the pulses of the two at 385 cps. Then, by calculating the sum of these two values and the difference between them, it obtains the east-west and north-south coordinates and displays them by counters as in the first system.

## Expansions, Changes In Avionics Industry

Litton Industries, Inc., will purchase Maryland Electronic Manufacturing Corp., College Park, Md., producer of navigation aids, radar antennas and telemetry equipment. William R. Morse will continue as president of new acquisition whose sales this year are estimated at $3 million.

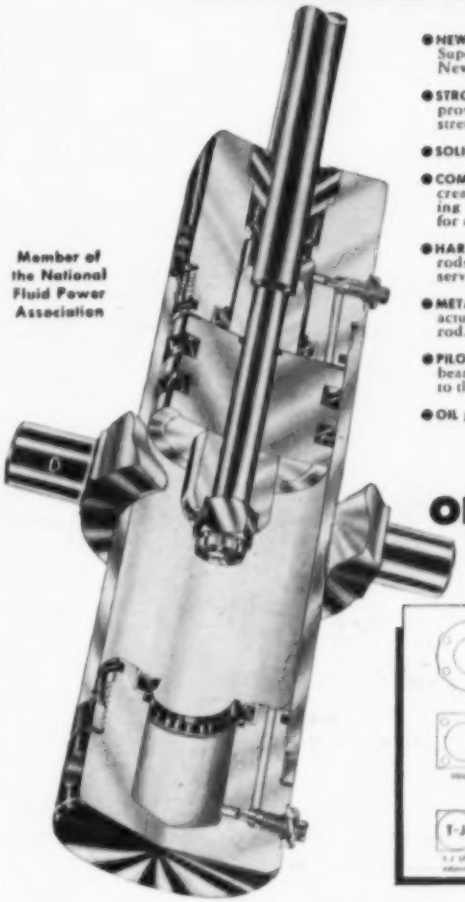
Other recently announced expansions, changes and mergers in the avionics industry include:

• **Vard, Inc.**, Pasadena, Calif., maker of electro-mechanical avionics devices, has been purchased by group headed by John A. Swint, former Ford Motor Co. production executive who becomes new president of Vard. Company founder, Vard Wallace, will be employed as a consultant.

• **Siegler Corp.**, Los Angeles, has merged with Unitronics Corp. and the


all the EXTRAS are standard with

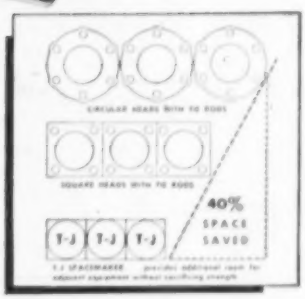
T-J Spacemaker CYLINDERS



Member of the National Fluid Power Association

- **NEW** *exclusive* ingenious cushion designs . . . Super Cushion Flexible Seals for Air . . . New Self-Aligning Master Cushion for Oil.
- **STRONGER** than outmoded tie rod design, proven through actual tests. No tie rods to stretch.
- **SOLID STEEL HEADS** throughout the full line.
- **COMPACT DESIGN** eliminates tie rods, increasing the strength and reducing mounting space required, providing extra room for adjacent equipment.
- **HARD CHROME PLATED** body bores and piston rods . . . assure you of long trouble-free service. (Standard at no extra cost.)
- **METALLIC ROD SCRAPER**, not just a wiper, actually removes foreign matter from the rod.
- **PILOTED PACKING GLAND** with extra long bearing. Additional strength and support to the piston rod.
- **OIL** pressure to 750 p.s.i. AIR to 200 p.s.i.

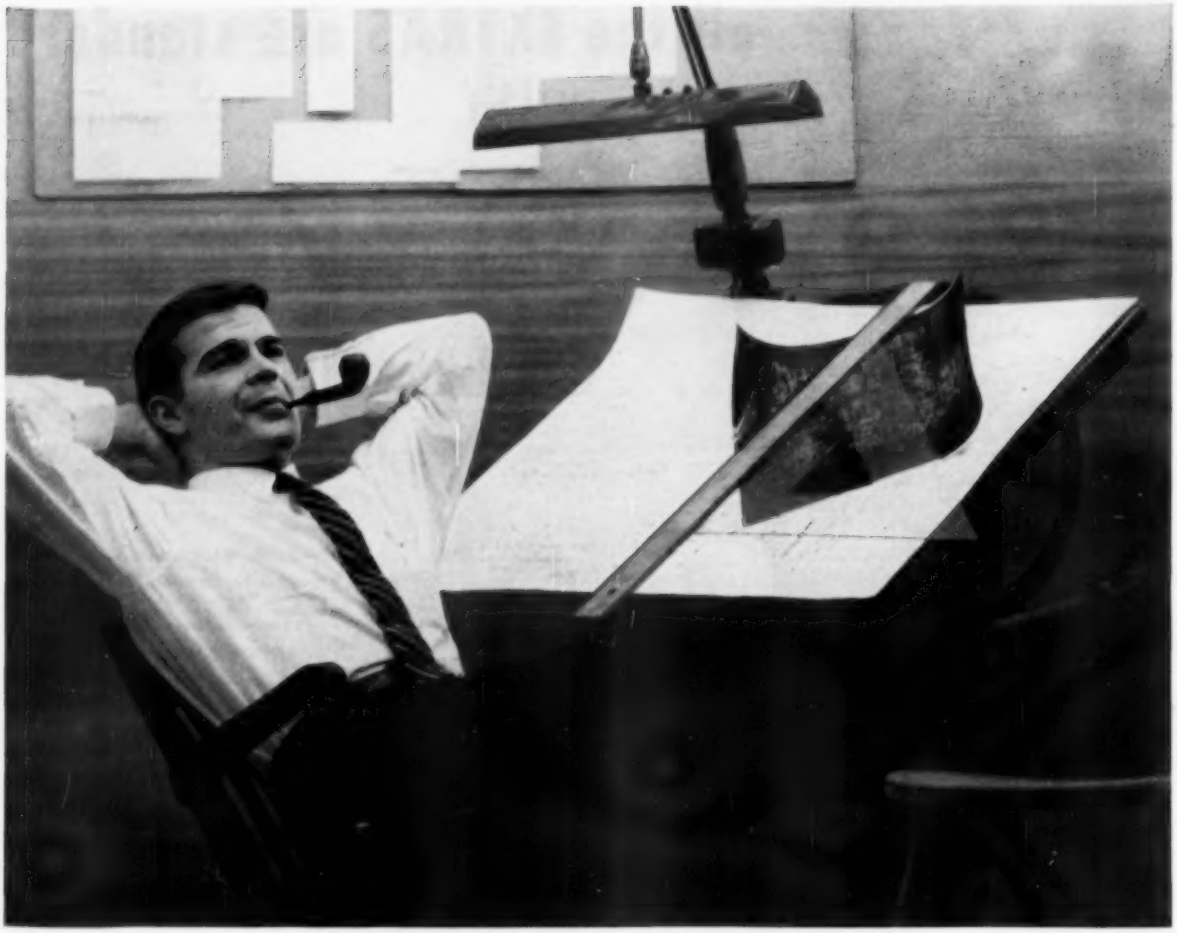
DELIVERY OFF THE SHELF!




You *save 40% space* when you switch from outmoded tie rod cylinders to the T-J Spacemaker! It's stronger, too! Fits right into automation programs in countless plants. Delivers top performance and dependability with a big *plus* in advanced features. Wide range of styles, capacities . . . reduces man-hours and costs in all kinds of push-pull-lift jobs. Off-shelf delivery in 64,000 combinations!

NEW LITERATURE—Send today for new Catalog SM56 with complete engineering details on Spacemaker line. Write The Tomkins-Johnson Co., Jackson, Mich.

T-J TOMKINS-JOHNSON
RIVETORS, AIR AND HYDRAULIC CYLINDERS, CUTTERS, CLINCHORS



## *new method solves* **DIFFICULT R-F NOISE** *problem*

Of course he's relaxed!

Faced with a new version of the same old r-f interference vs. space-weight problem, he came upon a solution that sidestepped the usual time, trouble, and expense . . . by calling on Sprague.

The perfect solution was found almost immediately among the more than four thousand filter designs already available from Sprague.

Even if his problem *had* required the weeks of research—special measurements and tests—Sprague field consulting service—he would be no less at ease.

With mass production facilities on both the East and West Coasts, deliveries are no problem either.

If you, too, have an interference problem, pick up your phone and call your nearest Sprague Electric Field Engineering Laboratory.

They are located at 12870 Panama Street, Los Angeles 66, California (TExas 0-7531 or EXmont 8-2791); 224 Leo Street, Dayton 4, Ohio (ADams 9188); 327 Marshall Street, North Adams, Massachusetts (MOhawk 3-5311).

**see SPRAGUE® for filters**

## Maser Series Reprints

**Reprints of Aviation Week's exclusive report on Maser (atomic) amplifiers, their principles of operation, advantages and possible future applications which appeared in August 19 and 26 issues, will be available shortly. Price is 25 cents per copy. Address requests to: Editor, Aviation Week, 330 West 42nd St., New York 36, N. Y.**

Hufford Corp., under the corporate name of Siegler. Latter is expected to gross about $75 million this year, about one-third of it in military electronics business.

• **Air Products (Great Britain) Ltd.,** is name of new firm formed by **Air Products, Inc.,** of Allentown, Pa., and **Butterley Co.,** London, England, which will manufacture and install oxygen and cryogenic equipment for British Commonwealth and European markets.

• **Tele-Dynamics, Inc.,** telemetry producer, has opened new 100,000 sq. ft. engineering-manufacturing facility at 5000 Parkside Ave., Philadelphia.

• **Clary Corp.** has consolidated its former Aircraft division and Automatic Controls division into single unit to be called Clary Dynamics, which will be headed by Paul J. Meeks as general manager.

• **Kin Tel division of Cohu Electronics, Inc.,** San Diego, manufacturer of instruments and controls, will open New York office with E. C. Titcomb, as manager.

## FILTER CENTER

▶ **Facsimile by Meteor Burst**—First successful transmission of facsimile by new meteor burst technique (AW June 17, p. 96) reportedly has been achieved by Radio Corporation of America. Air Force-sponsored tests were conducted over 800-mi. path between Havana, Ill., and Riverhead, N. Y.

▶ **"Servo-Roebuck" Approach**—To speed design and fabrication of breadboard servo systems, Servomechanisms' Mechatrol division will supplement own line of servo components with those of outside manufacturers to provide single source and immediate off-the-shelf delivery of more than 200 components most frequently needed. Company's "Sears Roebuck" approach includes catalog, complete with application data. Line of components will include precision amplifiers, potentiometers, modu-

**For fast single-point FUELING AND DEFUELING**

Weight saving and simplification of fueling operations are achieved through use of FRI GA-2 Adapter. This Adapter eliminates need for additional fueling points and associated plumbing by providing fast, efficient fueling and defueling through the aerial refueling probe on military aircraft. The GA-2 Adapter fits on existing MA-2 fueling nozzles and gives positive check on the operational status of aerial refueling receiver system during ground fueling thus eliminating need of separate check equipment.

Designed and produced by Flight Refueling, Inc., these components are flight-proved for production installations. FRI components simplify assembly and increase system flexibility.

***Also Available:***

**FRI CHECK VALVES** for aircraft systems are lightweight (less than 5 oz.), reliable, and extremely versatile. The CV-1 can be installed either by using standard beaded pipe connectors or it may be incorporated into any long tube merely by expanding a small section. These flight-proved valves are positive sealing and feature low "cracking" pressure and low pressure drop. Design makes it practical for use with most fluids and gases. Operating temperature range is −65°F. to 160°F.

**F-R PIPE CONNECTORS** — These versatile, flexible pipe connectors with a tolerance for minor misalignment of pipes and tubing save assembly time and speed production. They are light weight and pressure tight, and answer the problem of connecting beaded pipes in which high pressures must be accommodated. They have satisfactorily met flexure test of over 5 degrees and have been tested over 15,000,000 cycles of continuous vibration without leakage. Sizes 1" to 4" off-the-shelf; larger sizes to order.

*For specialized fuel system components to your specifications, contact Flight Refueling, Inc. Many production items immediately available.*

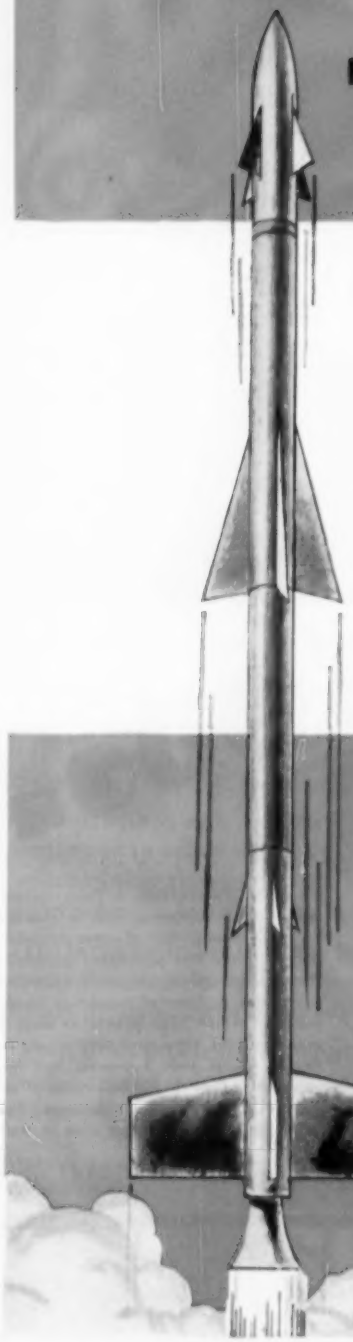
Flight Refueling, Inc.

FRIENDSHIP INTERNATIONAL AIRPORT · Baltimore 3, Maryland

SPEED YOUR MISSILE

# Titanium, Stainless Steel,

## FROM THE LEADING PRODUCER



Tolerances as close as ± 0.003″ can be achieved in the high-precision forgings produced at the Jet Division. These precise forgings can be made from titanium, stainless steel or high-strength alloys. For many applications, finish machining is eliminated, saving high labor costs and expensive scrap.

Make the Jet Division a part of your missile production program. By letting us produce forged and machined parts and weldments, you avoid the capital expense of your own facilities, eliminate the headaches of recruiting trained personnel, get your missile program under way faster.

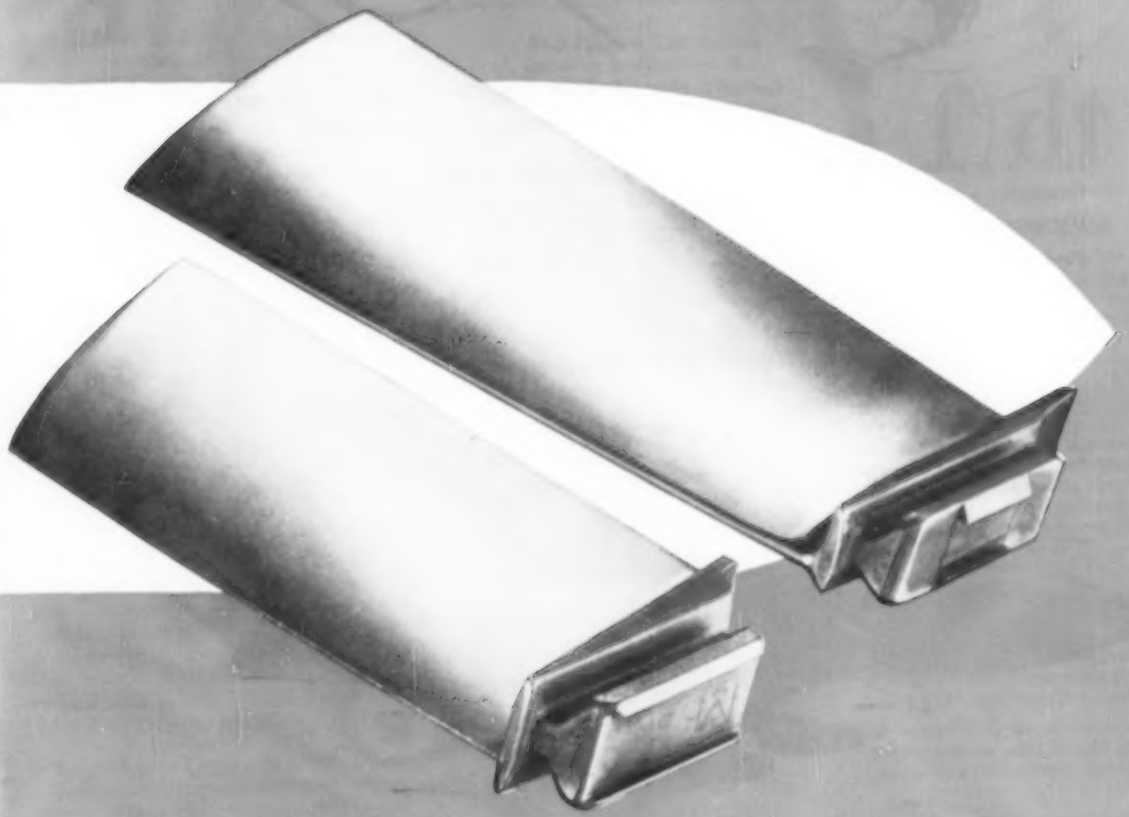
Our engineering and test facilities are also available to augment your missile plant. We can handle the complete job of producing missile air-frames, internal structures, and operating components.

**WRITE TODAY FOR BOOKLET AW-287** which describes the engineering and production facilities of the Jet Division. A sales engineer will call at your convenience to discuss our abilities.

PROGRAM WITH

# *and High-Alloy Forgings*

OF JET ENGINE PARTS



JET DIVISION

***Thompson Products, Inc.***

CLEVELAND 17, OHIO

# metal *sculpture* in motion.

BOEING 707

*"Introduction of the Boeing 707 jet airline transport will, in effect, make the world forty per cent smaller."*

Here is a concept which pioneers the highest in design performance, a concept fitted to the progress and comfort of modern transportation.

Performance such as this requires — better than the best — in SCULPTURED COMPONENTS of high strength to weight ratio.

The highly specialized technical personnel, engineering staff and production potential are currently available in the A.T.M. facilities.

ALUMINUM TAPER MILLING

DIVISION OF ALTAMIL CORPORATION

225 OREGON STREET
EL SEGUNDO, CALIFORNIA

WM. NORTHERN FIELD
TULLAHOMA, TENNESSEE

lators, power supplies, 60 and 400 cps. motors, synchros and precision breadboard elements such as gears, shafts and supports. For a copy of new "Servo-Roebuck" catalog, MDA 58, write Servomechanisms' Mechatrol division, 625 Main St., Westbury, L. I., N. Y.

▶ **Digital Computer Who's Who**—New 439-page book which describes engineering and programming characteristics of 103 commercially available digital computers, including data on applications, cost, personnel needed to operate, power and space requirements, is now available from Office of Technical Services, Dept. of Commerce, Washington 25, D. C. Book, identified PB 111996-R, "A Second Survey of Domestic Electronic Digital Computing Systems," is priced at $7.00.

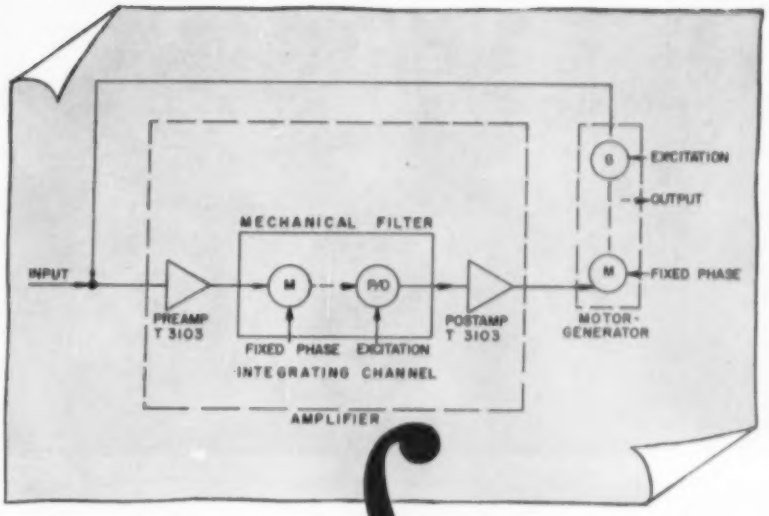
▶ **Now Hear This**—Recent Army report on performance of airborne avionics equipment during desert and high-altitude tests indicates unexpectedly high reliability. Lt. Col. Charles A. Merritt says: "Frankly, we expected more trouble, particularly with the more complex equipment." Merritt says Army "encountered no more difficulty than encountered in normal day-to-day operations in less rigorous environment."

▶ **Weight-Saving CRTs**—Six new 12-in. cathode ray tubes for radar indicator use, which employ electrostatic focusing, magnetic deflection, have been announced by Sylvania. Company estimates 2 lb. weight saving by elimination of external focusing coil. Tubes, available in three types of phosphors, are identified as types 12ABP7, P7A, P14, P14A, P19 and P19A.

▶ **High-Flying Avionics**—Functional and environmental tests on inertial guidance components have been accomplished at near 90,000-ft. altitudes. Components, developed by North American's Autonetics division, were carried aloft in four balloon flights conducted by General Mills.

▶ **Long-Hop Tropo Scatter**—Tropospheric scatter communications system which is expected to provide 600-mi. range for both voice and teletype channels, reportedly the longest single-hop tropo system ever built, will be constructed by General Electric's Technical Products Dept. for Air Force use in the Arctic. New UHF tropo scatter system will employ single sideband transmission, 50,000 watt transmitters. Contract price is $5.1 million.

▶ **Missile Component Contract**—Components for arming and detonating system in the Nike-Hercules will be produced by W. L. Maxson Corp. under $2,050,000 contract with U.S. Army Ordnance Corp.


This diagram illustrates an optimum configuration of a precise integrating servo system. The essential components are shown below.

$$\int (f)\,dt$$

**SERVO MOTOR GENERATOR**

This size 15 unit represents the latest in design for precise integrating tachometers. Temperature stabilized to within 1° C; linearity, 0-3600 R.P.M., .03% of 3600 R.P.M., 0-4800 R.P.M., .05% of 3600 R.P.M.

**MECHANICAL FILTER**

This size 11 filter, used in conjunction with amplifiers shown, provides an integral-plus-proportional circuit. Eliminates quadrature and noise in the error signal and the need for high gain, critical amplifiers.

**TRANSISTORIZED AMPLIFIERS**

This T3103 amplifier provides a 40 v., 6 w. output. Meets the requirements of MIL-E-5400. Dimensions 1⅝" x 1⅝" x 1⅞" high, weight 4.7 oz.

The above units are available as components for your specific applications or as packaged sub-assemblies.

**KEARFOTT COMPONENTS INCLUDE:**

Gyros, Servo Motors, Synchros, Servo and Magnetic Amplifiers, Tachometer Generators, Hermetic Rotary Seals, Indicators and other Electrical and Mechanical Components.

**KEARFOTT SYSTEMS INCLUDE:**

Directional Gyro Compass Systems, Three Gyro Stable Platform Systems and Inertial Navigational Systems.

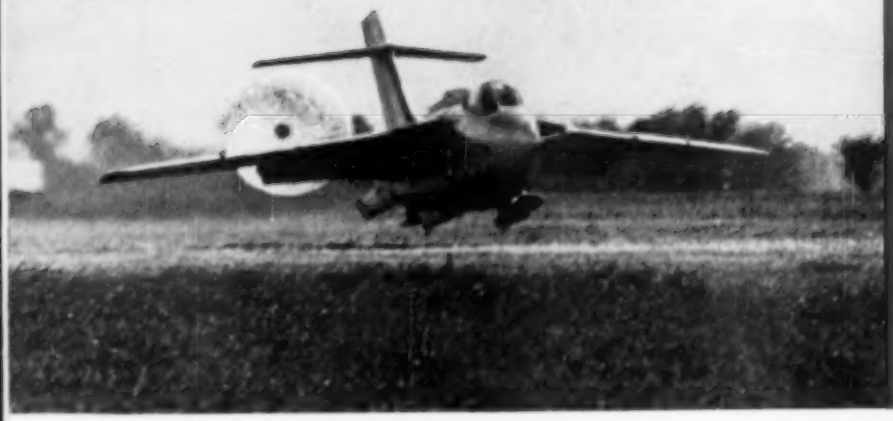
Kearfott

GPE

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

**KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.**

Sales and Engineering Offices: 1378 Main Avenue, Clifton, N. J.
Midwest Office: 23 W. Calendar Ave., La Grange, Ill. South Central Office: 6211 Denton Drive, Dallas, Texas
West Coast Office: 253 N. Vinedo Avenue, Pasadena, Calif.



# Baroudeur Performs at NATO Evaluation of Tactical Fighters

Landing (opposite page) and takeoff sequence (this page) of Sud Aviation Baroudeur was taken at Bretigny, France, where NATO is evaluating five entries in competition for a lightweight tactical strike fighter able to operate from unprepared fields. Baroudeur is equipped with skids—not conventional gear. Retractable hooks dig into ground, are supplemented by drag chute.

## Taon Competes For NATO Role

Breguet 1001 Taon (Horsefly) takes off during recent NATO lightweight tactical fighter trials. Gunports are visible just under the aircraft's unusual ramped inlet. Rapid ground servicing is beginning below. Note landing light in flush installation on nose wheel door. Large low pressure tires are used to aid in meeting rough field requirements.

# How magnetic tape converts blueprints to parts

## *From numbers to metal without templates or models*

*Photo Courtesy of Lockheed Aircraft Corporation*

This part was made with "production tooling" that cost less than conventional machining on a single sample. The "tooling" was a reel of magnetic tape programmed from blueprints by computer and electronic director. In a kind of machine-shop black magic, the part sprang into being on a Giddings and Lewis Numerically Controlled Milling Machine. Much larger parts are also similarly made on this same mill.

### NOW AT WORK IN ACTUAL PRODUCTION

This is not just a futuristic experiment. A commercial version has been delivered to a number of manufacturers. The first, at Lockheed Aircraft Corporation, produced 96 different complex parts in its second month of operation. Lockheed is using the tape-controlled mill to improve tolerances, eliminate human error and cut machining costs – often by over 50% ($21.32 versus $69.50 per part on one item). It is used for cams, templates and other intricate tooling – also for production parts on Lockheed's supersonic F-104 "Starfighter."

From initial experience at Lockheed, tape-controlled machining shows promise of reducing lead time from drawing board to production of parts by 60 to 70 percent. Since the "complete sets of tooling" are reels of tape, they can be stored as neatly as a row of books. Additional production runs can be made with a minimum of setup.

Earlier, at the Giddings and Lewis factory, tape-controlled milling was used to make one-of-a-kind cams and templates for tracer-controlled machines. Cost on a competitive bid basis was less than 50% of that for same work by conventional means. Ironically, this intricate tooling is what numerical control will eliminate wherever it supplants tracer-controlled machines.

### A SIMPLE WAY TO HANDLE A MILLION COMMANDS

For the numerically controlled mill, magnetic tape provides 200 commands per second, each defining exact tool positions in three linear coordinates (angular coordinates too, on some). A minimum signal commands only 0.000125 inch of tool motion. One reel of tape programs up to 1½ hours of machine time.

These closely spaced commands are ideal for a self-correcting system of servo controls. Also they eliminate need for expensive computing and interpolating equipment at the individual machine. Centralized programming can make tapes for many machines and is not tied to the time-consuming repetitions of actual production.

With its fourteen tracks, a one-inch magnetic tape has ample reserve for extra functions. Six are used for tool-position coordinates. The others control start, stop, coolant, and even voice instructions for impending tool change. Tracks can even be shared by several functions, allowing still further expansion.

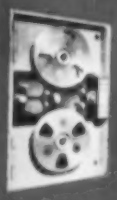
*Control tape on an Ampex FR-100 can hold over 1 million commands for each axis of tool movement*

*We will be glad to furnish more facts on magnetic tape recording and its use in machine tool control. Write Dept. UU-8.*

MAGNETIC TAPE APPLICATIONS BY AMPEX

8

ONE OF A SERIES



Series FR-100

Series 800 Mobile and Airborne

Model FR-800 Digital

Series FR-700 Loop Recorders

Series FR-1100

AMPEX CORPORATION

INSTRUMENTATION DIVISION

FIRST IN MAGNETIC TAPE INSTRUMENTATION

934 CHARTER STREET · REDWOOD CITY, CALIFORNIA

*District offices serving all areas of the United States and Canada; Foreign Representatives in countries around the world.*

# Why P&H Low-Hydrogen Electrodes eliminate costly rewelds on "difficult" steels

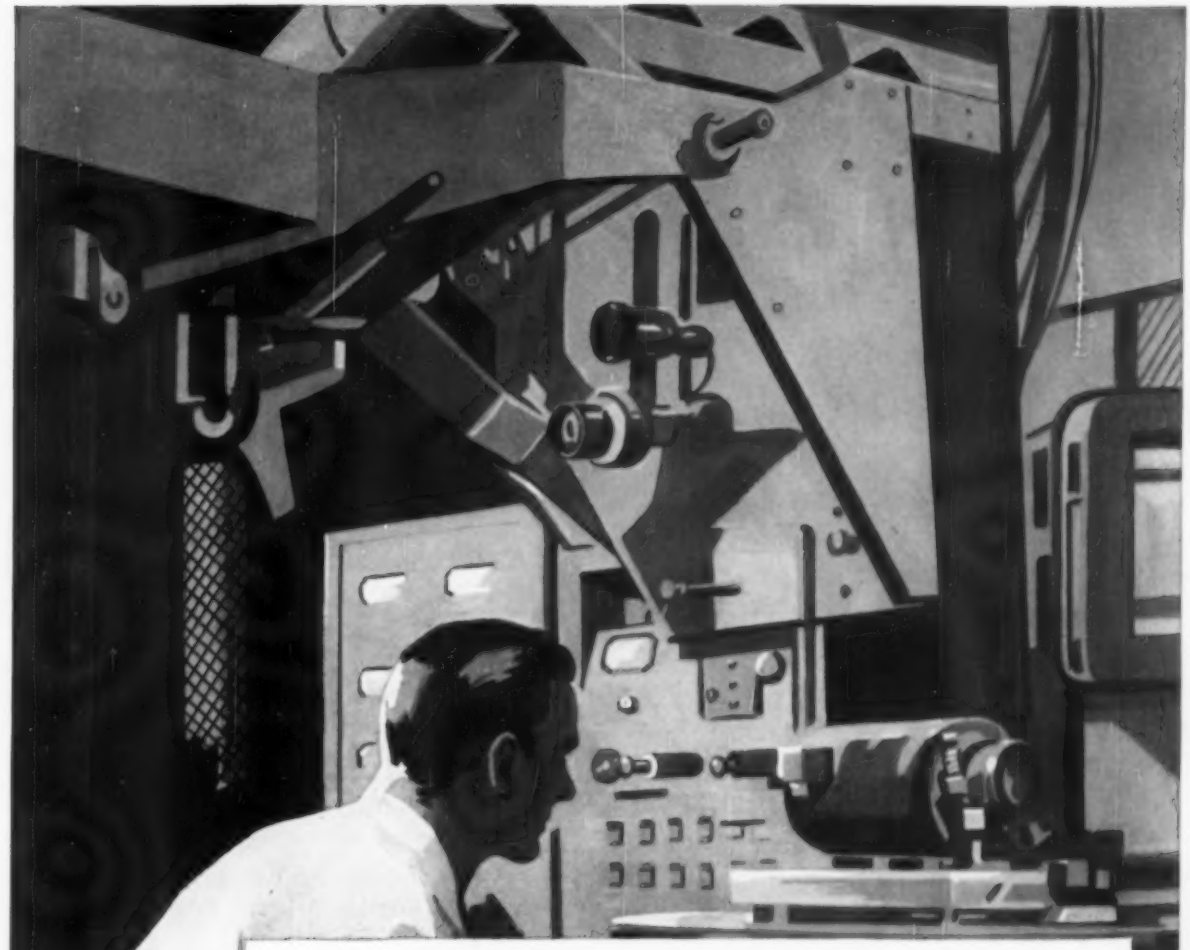
Alloy steels can be welded right the first time when you use P&H Low-Hydrogen electrodes. That's because the unmatched P&H electrode line is industry's largest — enables you to select the electrode that matches the chemical and physical properties of a wide range of problem steels.

This correct combination gives you better impact properties, faster deposition, and deeper penetration. Because these P&H electrodes prevent underbead cracking and porosity, you get high-quality x-ray welds with little or no preheat and at much lower cost than is possible with higher-alloy electrodes.

To find out more about low-hydrogen electrodes, write to Dept. 324H, Harnischfeger Corporation, Milwaukee 46, Wisconsin, and ask for Bulletin R-26.

**HARNISCHFEGER**

P&H WELDERS • ELECTRODES • POSITIONERS
MILWAUKEE 46, WISCONSIN



**PROJECT AND SENIOR PROJECT ELECTRONIC**

# ENGINEERS

Advance your knowledge, talents and personal growth in the most modern engineering and research laboratories. Gain swift, sure technical progress. Enjoy top responsibility, professional recognition including all AC-GM material benefits and advantages.

If you have a BS degree either as an EE or ME and have three to ten years applicable electronic experience, we offer you a broad range of challenging opportunities in the fields of *Avionics, Inertial Guidance, Computers (Analog-Digital), Jet Engine Fuel Controls, Automotive-Aeronautical Electro-Mechanical Devices.* Send resume *Mr. Cecil E. Sundeen, Supervisor of Technical Employment.

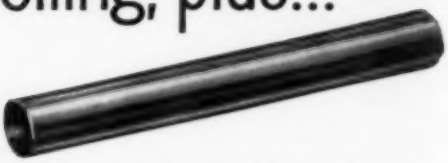
**AC THE ELECTRONICS DIVISION**

## General Motors Corporation

**Flint 2, Michigan • *Milwaukee 2, Wisconsin**

# ...at 40,000 ...climbing

## tested for today's ceiling, plus...



As machines and man fly higher and higher, materials like the thin-wall tubing made by Western Pneumatic Tube Company must be able to withstand greater extremes of vibration, temperature and pressure.

Thin-wall metallic tubing, available in many types of metals, is made in diameters from ½" to 8", wall thicknesses from .002" to .050", and is tested and approved for aircraft of today and tomorrow. A versatile product, Western Pneumatic Tube Company's tubing may be fitted to any aircraft design problem. Send for booklet giving details of product.

**WESTERN**

**PNEUMATIC TUBE COMPANY**

**KIRKLAND, WASHINGTON**

**Warehouse Distributors:**

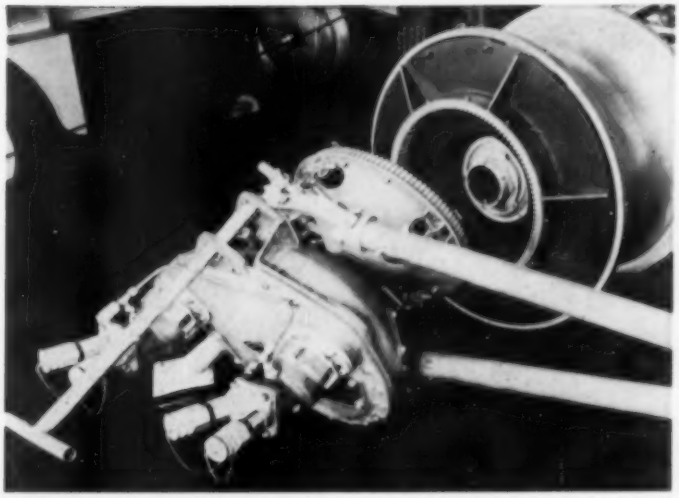
Perry Kilsby, Inc.
Los Angeles, California

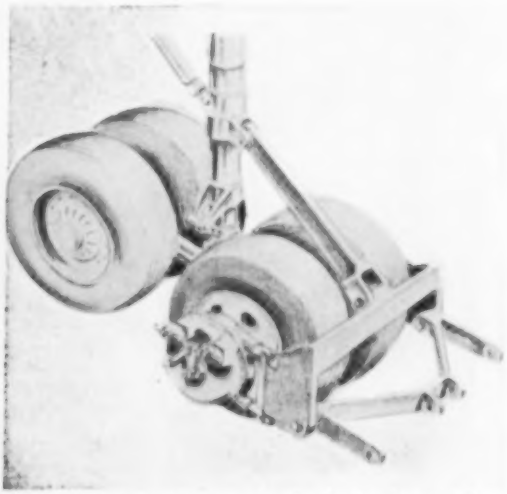
Tube Distributors Co., Inc.
Garden City, L. I., New York

**Sales Agents:**

Associated Industries, Inc.
Wichita, Kansas

C. P. Waggoner Sales Co.
Grand Prairie, Texas





**PROTOTYPE** Wheel Mover (left) shows twin hydraulic pumps which power it, ring gear to transmit power to plane's wheels. Sketch at right shows how Wheel Mover would be attached to main gear wheel. Arm to strut takes out torque, yoke propels power vehicle.

# Plane's Weight Gives Tow Unit Traction

By George L. Christian

**New York**—Last fall the concept of propelling heavy aircraft by hooking a torque converter on to the main wheels and using the plane's own weight to provide required traction was just an idea (AW Oct. 22, 1956, p. 82). But the theory has materialized into operating hardware.

Equipment has been designated "Wheel Mover" by its designer and builder, Consolidated Diesel Electric Corp. System consists of power vehicle and two wheel movers which attach to main landing gear wheels. Wheel mover will begin tests on Boeing's prototype 707 at Seattle Oct. 21.

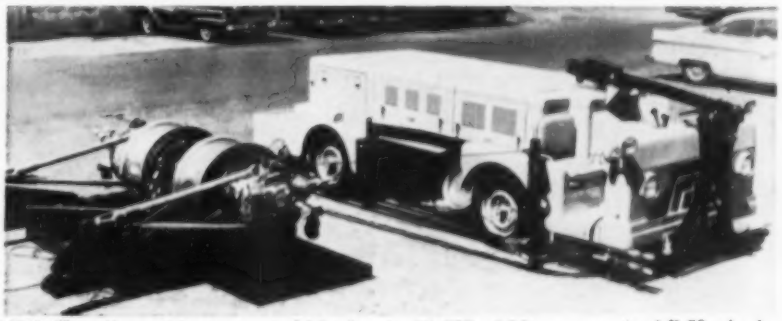
Air Force has established a requirement for this type of equipment relative to very heavy aircraft.

Equipment was demonstrated recently at Consolidated Diesel Electric's Stamford, Conn., plant where it drove a pair of B-52 wheels at speeds equivalent to a maximum of 5 mph. forward and reverse against brakes set to simulate the equivalent of 200,000 lb. inert weight.

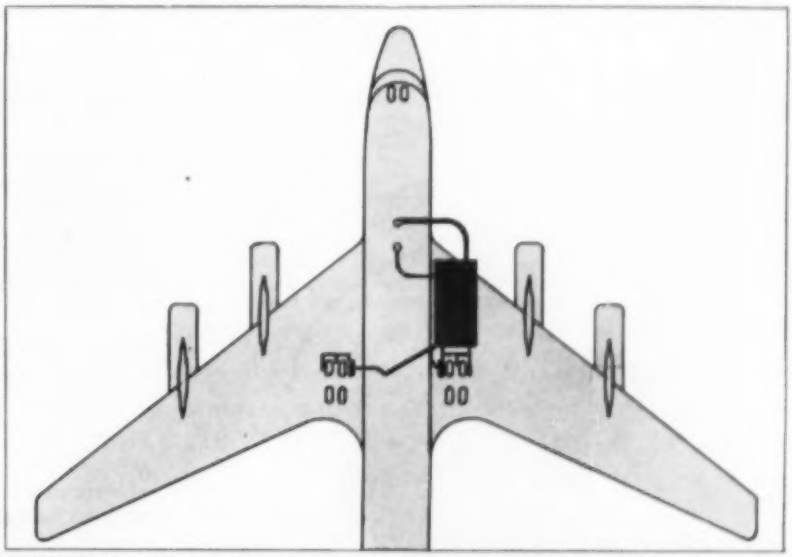
### Tough Tow

In recent studies, Con Diesel engineers concluded that "towing by conventional tug or tractor is not a good approach for aircraft grossing over 150,000 lb.

"For aircraft the size of a Boeing 707 or Douglas DC-8, it has been computed that the drawbar pull to unstick the aircraft and afford satisfactory ground movement has to be 20,000 to 30,000



**LOW** silhouette prototype power vehicle shown with Wheel Movers on pair of B-52 wheels.



**DRAWING** shows how power vehicle is attached to front of plane's right main gear to supply power to inboard front wheels and a.c. current to plane's electrical system.

## RADAR THAT PUTS THE FINGER ON STORMS

Man's newest ally in his eternal battle with the elements is Raytheon Storm Detector Radar. Already, military versions of this radar are providing invaluable help in tracking destructive storms and in issuing timely advance warnings. Next year 39 new units are scheduled to keep watch around-the-clock for the U. S. Weather Bureau.

Each radar pinpoints storms in a 300,000 square mile area, "sees" drizzle, snow, fog or probes deep into the heart of a rain-lashed hurricane.

Here is another example of how military and civilian electronics are teaming-up to help safeguard America.

RAYTHEON

*Excellence in Electronics*

**RAYTHEON MANUFACTURING COMPANY, WALTHAM 54, MASS.**

lb. This does not take into account the loss of traction due to wet or icy pavement. Moreover, cost of the conventional towing unit will be high because it must weigh over 25,000 lb., and the cost of steel, rubber, cast iron and sheet metal in any article of this type is more than $1 a pound on today's market."

Consolidated Diesel's conclusion appears to be borne out by Air Force experience with the 350,000-lb.-plus B-52. A spokesman at a northern B-52 base told AVIATION WEEK that icy ramps posed tough tow problems for B-52s.

### Current Solutions

Standard current towing unit is a 40,000 lb. Euclid tractor that costs approximately $38,000. While the unit works well in good weather, as soon as ice hits, base maintenance personnel are forced to hook two, and sometimes three, in tandem to move the big bombers. This is particularly true when the B-52s have to be moved up a 2.7% grade on one ramp.

Other schemes involve deflating tractor tires and sanding runways for better traction.

The same officer noted the trend in tractors. Last winter, representatives from USAF's Wright Air Development Center spent a month at his base testing a Le Tourneau tractor weighing some 55,000-60,000 lb.

As he said, "The use of increasingly large masses to move an existing mass does not seem to be the logical answer."

He added that, in his opinion, the use of a torque converter which takes advantage of the plane's own weight to provide necessary traction seems to be the correct approach to moving the big planes over icy runways or up grades.

### Wheel Mover Operation

Here are details of Consolidated Diesel's Wheel Mover system components:

- **System** is made up of one 6,000 lb. mobile power vehicle, called model 60E (HD), and two- or possibly four-WMU-250 wheel mover units, and a remote control for the pilot.
- **Single** 250 hp. engine, probably a Ford V8 industrial powerplant, will supply power to propel the vehicle to the plane and the plane itself after the unit has been hooked up to the aircraft's wheels.

Since the engine is also used to drive a 90 kva. (or more) alternator to power the plane's electrical system, either while it is moving or stationary on the ramp, the engine will be closely governed to run at a constant rpm. as required by the alternator.

Plane's speed will be regulated by altering the flow of the variable dis-


**ROCKET POWER PROGRESS REPORT**

# Taming Rocket Powerplants

*by Walter O. Borcherdt*

*In charge of the Engineering Development Laboratory as well as the Valves and Controls Section at RMI, Mr. Borcherdt has over a decade of rocket experience. Before coming to RMI in 1951, he was senior project engineer on controls in the rocket department of Curtiss-Wright Corporation. Mr. Borcherdt received his degree in mechanical engineering from Stevens Institute of Technology in 1938.*

Reliability of a rocket powerplant is the direct result of the simultaneously correct operation of all of its elements. Generally, this is assured by overcoming each element's own peculiar development problems. Among these elements is one type which has the interesting property of being composed of specific components, yet whose operational characteristics are significant only in the performance of the entire powerplant system. This element is the control system.

Present powerplant controls requirements are based on these straightforward, simple considerations:

1. **Prepare the powerplant for firing**
2. **Sequence and control the system to rated thrust**
3. **Vary thrust rapidly and safely as required**
4. **Shut down smoothly**

Step one may require the use of gas pressure regulators and relief valves to push the propellants safely from tankage to pumps. There must be switches and relays to indicate or control the valves which admit propellants to the gas generators and combustion chambers, and time delay cutouts to insure against unsafe accumulation of propellants.

In step two, ignition and combustion may be monitored to insure correct use of the high energy release rates. Turbines may be safely brought up to speed by throttling the propellants. Safety devices may be added to limit over-speed and avoid the danger of structural failure.

In step three, a controller (it may be hydraulic, electric, pneumatic, or a combination) is used to vary thrust. Here multiple loop servo systems are sometimes used to insure that thrust change rates, turbine speeds, vehicle acceleration or terminal velocity, and other parameters vary in a coordinated manner.

Finally, in multiple stage powerplants or piloted vehicles, the rocket engine must be shut down safely and the system automatically purged of propellant accumulations.

The successful implementation of these four steps involves the application of many devices of unique characteristics whose individual selection is intimately tied to the following question:

"What is the actual control system problem to be solved?"

Once this question is clearly and consistently defined, a tight performance envelope results. This makes the few possible solutions fairly obvious. The final stage is to apply the knowledge of a team of control specialists and proceed through the usual component development stages. At RMI, this team of specialists in controls engineering is made up of highly qualified mechanical, electrical and chemical engineers. These professional men have wide experience in the creation of control units and systems for rocket powerplants as well as other types of propulsion systems. However, there is a continuing need for qualified graduate engineers, able to participate in working closely with other groups of specialists, integrating the control system into the overall engine performance envelope.

The systems approach is of extreme importance to successful rocket powerplant control efforts. It is a standard approach of the RMI Controls Section. Sequence system design, switching circuit analysis, human engineering, feedback control methods, statistical procedures, information theory and latest research data on fluid flow control are among the techniques used. They are applied along with practical design concepts which result in the development of simple but effective controls systems.

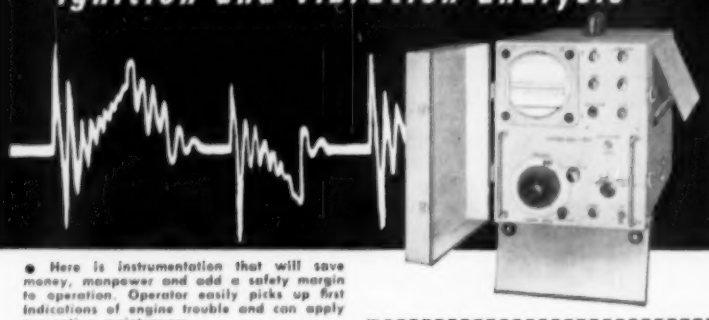
*If you desire one or more reprints of Mr. Borcherdt's article, or would like to receive further information about employment at RMI, write to our Information Services Coordinator, Reaction Motors, Inc., Ford Road, Denville, New Jersey.*

Power for Progress

RMI

# LAND-AIR ENGINE *Analyzer*

***Low MAINTENANCE COSTS . . . . improved FLIGHT SAFETY with engine ignition and vibration analysis —***



● Here is instrumentation that will save money, manpower and add a safety margin to operation. Operator easily picks up first indications of engine trouble and can apply preventive maintenance.

THE Land-Air Engine Analyzer is designed to be compact and to afford every possible convenience for the operator. All controls have been brought together into a single compact package. This means that the operator never is required to take his eyes or hands off the instrument for a single instant during an actual analysis operation.

The airborne model can be located on the flight deck of an aircraft while the ground portable model can be used in normally lighted laboratories, test cells, or on aprons.

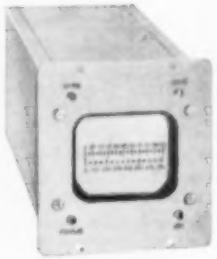
The Engine Analyzer provides rapid and accurate inspection of engine ignition and mechanical malfunctions during flight or in preliminary examination on the ground. This means longer life for engines and contributes to flight safety.

Simplicity of design, compactness, lightweight, easy-maintenance, easy to install and ruggedness are all features of this specially engineered analyzer that has a minimum of parts producing a maximum of efficiency.

## *The* INFLIGHT 136

### AIRBORNE ENGINE ANALYZER

***for use with high or low tension ignition systems***



*General Specifications:*

Power Requirements—115 Volt A. C. 400 cycle, single phase.

Power Requirements (total) — 250 watts.

Total Volume—Less than 0.7 Cu. Ft. Meets or exceeds all the requirements of MIL-A-19129 (AER) and MIL-A-9207B (USAF)*

The INFLIGHT 136 incorporates the vibration selector switch into the switching module. This reduces the number of individual units and cabling required for a complete system.

This instrument displays information on the face of a cathode ray tube — tells instantly if and what spark plug is faulty, primary and secondary circuit faults such as short and open circuits, breaker points bounce or arc, distributor spark advance, prop synchronization, etc.

*Also applies to the Ground Portable Engine Analyzer

**LAND-AIR Inc.**

*Subsidiary of California Eastern Aviation, Inc.*

7446 WILSON AVENUE • • UNderhill 7-7550 • • CHICAGO 31, ILLINOIS


placement hydraulic pumps driven by the engine. Similarly, the speed of the vehicle when being driven to and from the plane will be regulated through a variable displacement pump driving the unit through an automotive-type differential.

Consolidated Diesel anticipates no problem in supplying movement and electrical power simultaneously. Breakaway power requirements may present a problem which could require programming to solve.

The power vehicle will be of low silhouette to minimize danger of colliding with the plane.

Pneumatic power for starting the plane's jet engines can be supplied by a pneumatic power pod mounted on the vehicle without any structural modification. Pneumatic power source can be a gas turbine compressor, engine-driven high speed blower or air bottle with an air heating attachment.

Plane's air conditioning system can also be powered by the gas turbine compressor.

### Operation Sequence

Assuming an aircraft arrival, here is how the wheel mover system would be put into operation.

As soon as the plane has taxiied off the active runway to a holding area far enough away to prevent traffic jams, the power vehicle is driven up. While the pilot is going through his engine shut-down procedures, two men attach the power cart to the plane and hook the wheel movers to the plane's wheels in one minute.

Current idea is to attach the power vehicle to the plane's right main gear by inserting a long metal arm through existing tow lugs. Vehicle would be in front of the wheels. Right side was chosen to keep the vehicle away from passenger loading facilities which have been standardized on the left side of most new planes.

Wheel movers are attached to four of the plane's eight main wheels. On the 707, plan is to attach units to the four inboard wheels, two front and two rear. In this manner each pair of front and rear wheel movers can be mechanically connected so that each acts as the other's torque reactor.

On the DC-8, the rear wheels of the bogies will be free to caster, or trail, through an arc of approximately 40 deg., making the fore-and-aft wheel mover arrangement impractical. CDEC says there are many ways to get around this problem. One suggested solution would be to put the wheel movers on the plane's four front wheels. Then torque reactor linkages could be fitted into the hubs of the rear wheel axles.

Power from the wheel movers is transmitted to the plane's wheels through a spur gear in the wheel mover

## PRESENTING THE HARDMAN *Starest*

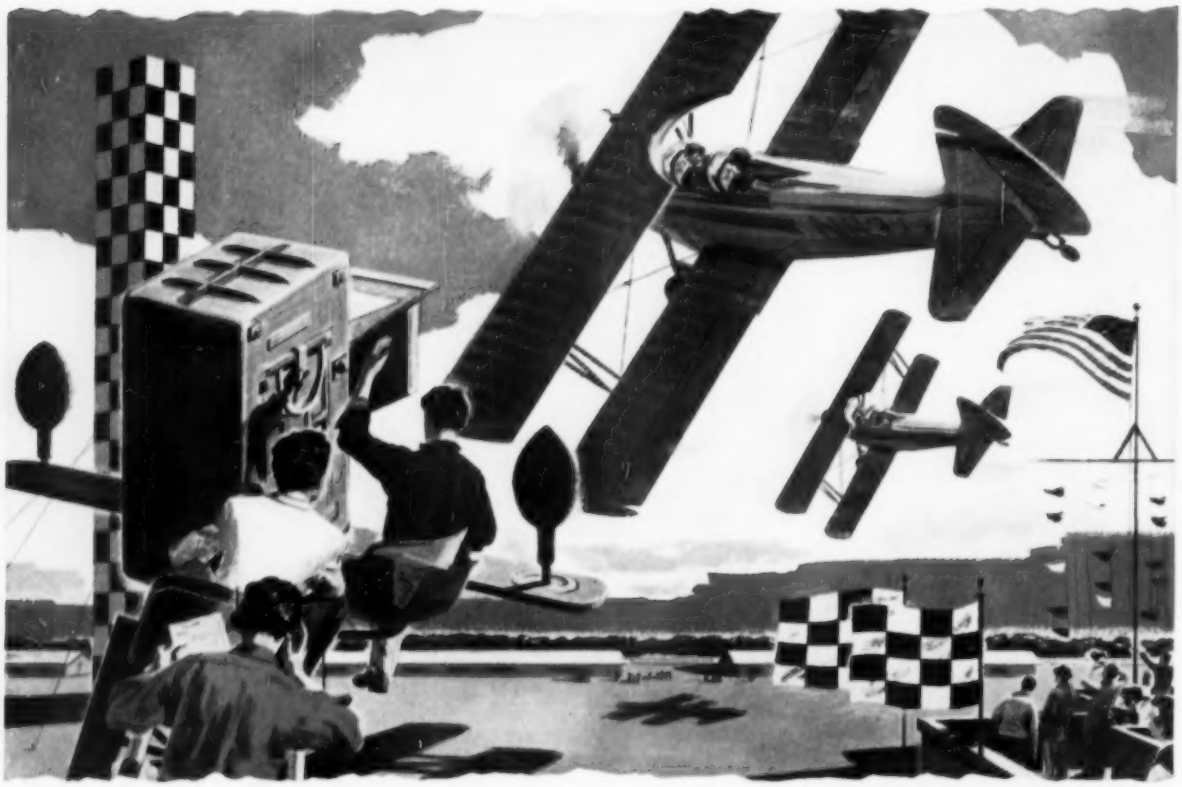
Here's an *entirely new* chair concept to meet current need for ultra high density seating. Its clean sculptured lines impart a feeling of spaciousness, yet design simplicity permits substantial savings in weight, space, and ease of maintenance without sacrificing passenger comfort. The Starest reflects Hardman's years of design-manufacture experience. It sets new high density passenger comfort standards for any airliner.

**HARDMAN TOOL & ENGINEERING COMPANY**
1845 S. Bundy Drive, Los Angeles 25, California

PROUDLY WE SERVE MORE THAN 70 OF THE WORLD'S GREAT AIRLINES

# PLANE FAX

*by* STANDARD OIL COMPANY OF CALIFORNIA



## Realism in the movies with daredevil flying

When a movie script calls for pilots and planes to re-enact daredevil flying of the early 1930's, the producers often call on Joe Pfeifer. Hazardous flying of outdated aircraft is bread-and-butter work for him. Operating out of the Santa Susana Airport, in California, he and his fleet of 1930 vintage airplanes have appeared in many motion pictures based on early-time flying adventures.

"Hollywood makes two strong demands when shooting a flight scene," reports Mr. Pfeifer. "One is full power for realism and the other is minimum maintenance problems to eliminate production holdups. I get both with Standard aviation products. Chevron Aviation Gasoline burns clean, never fouls the plugs and gives me the extra power I need for movie stunt flying.

"RPM Aviation Oil keeps the aircraft in top condition and holds engine wear to a minimum. Rings and valves stay clean as new. I've had no engine trouble using RPM . . . and in my kind of flying that's saying a lot."

Mr. Pfeifer's fleet of 27-year old planes, the largest such group of aircraft still flying, includes a restored and modified Pfeifer fleet biplane, Phillips Skylark, Davis DWL and a Fairchild 22.

### TIP OF THE MONTH

Avoid flying immediately below or above a cloud formation. Neither is a good place to be should another airplane suddenly pop out of the overcast.

*We take better care of your plane*

CHEVRON AVIATION GASOLINE

AVIATION OILS RPM

T.M.'S "RPM," "CHEVRON," "PLANE FAX," REG. U. S. PAT. OFF.

1937
20 YEARS
OF PROGRESS
Bendix-Pacific
Pacific Division of Bendix Aviation Corporation has two decades of knowhow under its belt. During the first year of its existence Bendix-Pacific was proud to supply its equipment to three aircraft companies. Now, in 1957, Bendix-Pacific hydraulic, electronic or electro-mechanical components and systems are specified by all major U. S. aircraft companies and are in service on every modern airliner, on all different types of military planes and on the large majority of missiles and pilotless aircraft. Bendix-Pacific has earned this leadership through twenty years of progressing achievements. Its latest developments in advanced systems are proof of the diversity and flexibility of Bendix-Pacific engineering. The results can be measured in greater performance for you.
BENDIX PACIFIC DIVISION
Bendix Aviation Corporation
North Hollywood, California
20 YEARS in airborne hydraulics
14 YEARS in airborne electro-mechanics
20 YEARS in airborne electronics
11 YEARS in Sonar
10 YEARS in missile guidance
1957

Famous "Flying Saucer" Rotodome for the Navy's Lockheed WV-2 Constellation

# Bring your tough ones to Zenith

This giant Rotodome was an engineering nightmare. It represented a whole new concept in Early Warning Radar equipment. Its airfoil shape and great size—38 feet in diameter—were a radical departure in radome design. It had to combine high strength with light weight, so that it could be *rotated in flight* with the radar antenna.

Working in close cooperation with Lockheed's engineers, we made the Rotodome of resin-bonded glass fiber. It met every requirement for strength, weight, and electronic consistency. And the entire job was completed—designed, engineered, tooled, fabricated, and delivered—*in 120 days.*

This is the kind of challenge we welcome at Zenith. We've learned how to form resin-bonded glass fiber in almost any shape and size... at production-line speed. We can simplify designs because structural plastics often eliminate the need for interior bracing. We can usually complete tooling in a fraction of the time needed for metal parts—and at lower cost.

Zenith's reinforced plastics are the *only* answer for some structural components—and a better answer for many. We invite you to "bring your tough ones to Zenith."

World's Largest plant producing reinforced plastics components for the U. S. Air Force, U. S. Army, and U. S. Navy. Applications include Aircraft and Missile Radomes • Helicopter and Missile Fuselage Sections • Aircraft and Missile Wings • Fairings • Fuel Tanks • Fire Bombs • Rescue Containers • Bomb Casings and Fins • Rocket Launcher Pods • Antenna Reflectors • Arctic Shelters • Boats • Minesweepers • Landing Craft • Small Sailing and Power Craft • Naval Craft Components • Buoys and Floats • Ducting • Ground Rigid Radomes • Land and Aerial Mine Housings • Shipping Containers • Storage Tanks

## Zenith Plastics Company

1600 West 135th Street, Gardena, California

Subsidiary of Minnesota Mining and Manufacturing Company

3M

FORM OF THE FUTURE: RESIN-BONDED GLASS FIBER

engaging a ring gear attached to the outer rim of the main wheels.

Con Diesel engineers say that Boeing has already installed the ring gears on the prototype 707. They represent the only necessary addition to the plane's structure and weigh a total of 16 lb. Bendix Products, makers of the wheels, has agreed to design the ring gear into future production wheels, which should reduce this weight.

Prototype wheel movers weigh about 300 lb. per unit; production units will weigh considerably less even than 300 lb. One man can easily roll the units from the power vehicle to the plane's wheels on their own casters and attach them with the single movement of a lever.

Insertion of an electrical cable plug into the vehicle connects it to the plane's electrical system to supply power as soon as the engines are shut down. Plugging action also causes the vehicle to be automatically jacked up by hydraulically-operated, full-castering wheels.

Pilot is then handed the wheel movers' throttle-like controls through the cockpit window, giving him complete control of the plane's ground movements.

With the controls, the pilot can start or stop his plane at will. He can inch it forward or backward as needed. Conceivably, he could drive one set of wheels backward, the opposite set forward and pivot the plane without any forward movement.

Feature of the system is that, without a tug and a tow bar in front of the plane, it can be nosed into tight quarters.

Plane also can be controlled by a mechanic who walks beside the plane.

Con Diesel engineers hope airframe manufacturers will eventually build wheel mover controls into the planes to which units can be plugged in. They estimate the weight penalty of such an installation at 10-12 lb.

### Advantages Claimed

Con Diesel spokesmen cite these advantages for their wheel mover systems:

- **Fuel saved** by taxiing jets with wheel movers will be considerable because of the inefficiency of jet engines at low altitudes and slow speeds.
- **Noise and jet blast** reduction around passenger terminal areas will be welcomed by all concerned.
- **Damage to jet engines** due to foreign matter ingestion while taxiing will be eliminated.
- **Movement of aircraft** over wet, icy or snow-covered ramps will pose no problem since the planes' great weight is used to provide the necessary traction. Under extreme conditions, it may pay to hook wheel movers to all eight main wheels.
- **Cost (about $22,000)** and weight (about 6,000 lb.) of the Wheel Mover system of moving very heavy aircraft is less than any other practical means of doing the job, Con Diesel officials believe.
- **Ground movement** of the plane is left with the pilot.
- **System can be fitted** to any aircraft with little or no modification.

Con Diesel officials are prepared to put the units into full production as soon as the demand arises. Total horsepower output, a.c requirements and compressed air needs for starting and/or operating aircraft air conditioning systems, can be designed to individual requirements.

## OFF THE LINE

**Three Lockheed** Super-G Constellations soon to be placed in service by Varig between New York and Rio de Janeiro will have eight berths—four upper and four lower—in the main passenger compartment. Planes will accommodate 63 passengers each.

**Airwork Corp.**, Millville, N. J., is consolidating and expanding its Atlanta, Ga., facilities in a new building just erected on a site two blocks from the Atlanta Municipal Airport. Facility will house sales, warehouse and acces-


# SECURITY • OPPORTUNITY • ADVANCEMENT

*for engineers in selected fields at General Mills*

Although engineering openings still make headlines across the country, the unvarnished truth is that all the positions offered to qualified engineers do not assure the kind of security and professional, progressive future an applicant has a right to expect or demand. **Recent localized situations and events have brought this job security and job opportunity situation into sharp focus for many today.**

If you're faced with an indefinite situation now, if your future status looks to be in jeopardy, look to General Mills and a forward, upward step.

You'll start with a good salary based on your proved ability and performance, and you'll have liberal company benefits. We can document the fact that we have challenging vital projects, assuring long-range security and rapid advancement for those qualified.

Then too at General Mills your career is with one of America's 100 largest, most diversified companies, a company which has grown and expanded year after year and has paid dividends without reduction since its formation in 1929.

GENERAL MILLS in Minneapolis Offers Other Values Too:

**FRIENDLY ATMOSPHERE**—work with congenial stimulating people who can share your interests.

**LOWER COST OF LIVING**—where dollars actually buy more and more can be saved.

**DELIGHTFUL RESIDENCES**—only minutes from the job are homes in resort-like settings.

**EXCELLENT SCHOOLS**—with low teacher-pupil ratio.

**TUITION REIMBURSEMENT**—take advanced work at the University of Minnesota under our liberal tuition reimbursement plan.

**TIME FOR FUN**—relax and play in the land of 10,000 lakes, winter and summer spectator sports abound.

As you ponder your engineering future, take time to investigate General Mills, where you can accomplish big things in the field you know and like best.

Send today for our new complete booklet giving the facts you want, outlining many opportunities for long-range careers if you qualify. All inquiries are confidential, of course.

**A LONG-RANGE FUTURE FOR YOU IN SUCH FIELDS AS:**

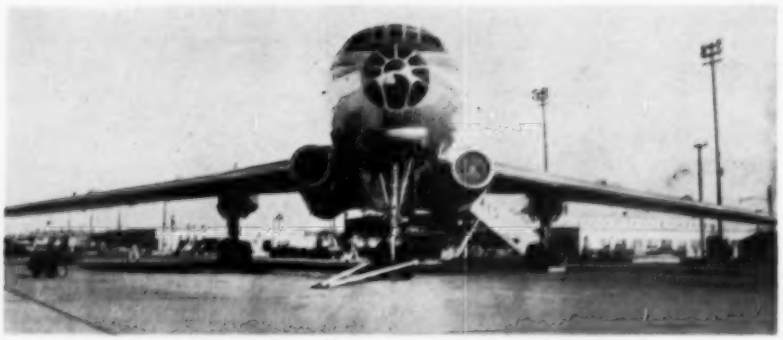
- MISSILES
- APPLIED MECHANICS
- GEOPHYSICS
- UNDERWATER ORDNANCE
- ELECTRONIC COUNTERMEASURES
- DIGITAL & ANALOG COMPUTORS
- INSTRUMENTS & CONTROLS
- SOLID STATE PHYSICS
- MICROWAVES & ANTENNAS
- INFRARED SYSTEMS
- INERTIAL SYSTEMS
- SYSTEMS ANALYSIS & DESIGN
- SERVOMECHANISMS
- BALLOON SYSTEMS
- INDUSTRIAL AUTOMATION
- UPPER ATMOSPHERE RESEARCH
- FINE PARTICLE TECHNOLOGY
- SURFACE CHEMISTRY
- OPTICS
- MECHANICAL DESIGN
- AIRBORNE EARLY WARNING
- RADAR SYSTEMS
- INFORMATION THEORY
- ELECTRONIC EQUIPMENT DESIGN AND MINIATURIZATION

***MECHANICAL DIVISION OF*** General Mills

Simply fill in coupon and send today for informative booklet that can help make your future rewarding and secure.

**Peter D. Burgess, *Personnel Director*** AP
**Mechanical Division General Mills**
**1620 Central Avenue Northeast**
**Minneapolis 13, Minnesota**

Name .....
Address .....
City ..... State .....
College ..... Degree ..... Year .....



## Russians Flew Tu-104A to U.S.

**Aircraft which flew Russian delegates to U. N. was an Aeroflot Tu-104A, newest configuration of the twin-jet transport. Interior has lightweight seats replacing heavy furniture of earlier model and old fashioned damask interior has given way to more modern decor (above). New interior seats 70 instead of 50 passengers (AW Aug. 12, p. 41). Front and side exterior views of the Soviet airplane were taken at Maguire AFB, N. J., where it landed.**

sory overhaul activities by the end of September. The instrument overhaul shop will begin operation approximately a month later.

**Prices** of Lima Electric Motor Co.'s products will not go up in spite of rising costs of raw materials and increasing wages paid employes. Company recently so advised 7,000 present and prospective customers, adding that the situation would be reviewed from time to time and, if any change were contemplated, ample notice would be given. Immediate reaction was an increase in orders for the company's electric motors. Lima Electric, Lima, O., is a subsidiary of Consolidated Diesel Electric Corp., Stamford, Conn.

**A $4½-million order** for gas turbine-powered airborne generator sets and spares has been awarded Solar Aircraft Co. by Air Force's Air Materiel Command. Sets, which will be installed in Boeing KC-97 Stratotankers, will act as independent d.c. power sources for the flying tankers for multiple uses such as: supplying electrical power when the plane is on the ground before engines are started; supplying current for aircraft's engine heaters under Arctic conditions; supplying d.c. power in flight in case of engine-driven generator failure. Strategic Air Command now has seven air refueling squadrons equipped with the units. Other planes using the airborne generators include Douglas C-124A, Lockheed C-121C and Convair C-131B. Generator set is powered by a Solar-designed and built Mars gas turbine which weighs less than 100 lb. and is smaller than a 2-ft. cube.

**Canadair's CL-28** long-range reconnaissance plane uses a specially designed refuel-defuel unit to speed fueling and defueling operations. Fueling can be accomplished at a 500 gpm. rate, defueling at 125 gpm. With a capacity

## Royal Swedish Navy Orders Vertol 44's

A special committee of the Swedish Navy made a year-long study of helicopters suitable for anti-submarine warfare as well as utility transportation. In the United States they consulted with headquarters personnel of the three armed services, visited helicopter manufacturers and toured military operating units.

At the conclusion of this intensive study, the Swedish Navy placed an initial order for four of the 22-place Vertol 44's, to be augmented later by additional procurement.

Official Navy announcement of the purchase said the choice was mainly based upon the Vertol 44's "good stability in hovering and towing missions, good instrument flight capabilities and mission endurance . . . practically unlimited controllability for the contemplated missions."

Sweden thus became the fifth western nation to purchase the sturdy Work Horse helicopter, first choice of the experts for the most difficult assignments.

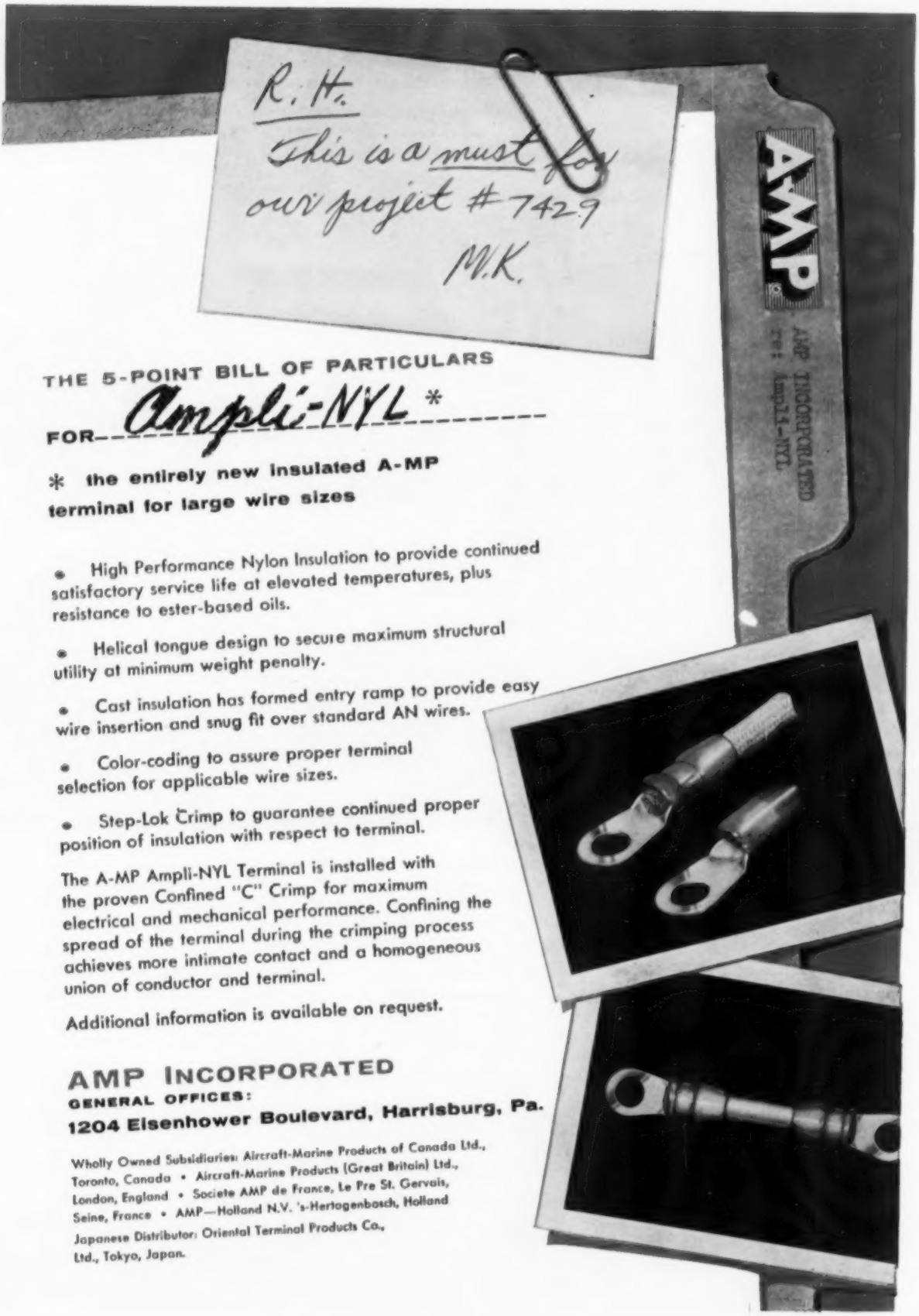
In commercial or military use the Vertol 44 offers these features:

- Highest useful load, largest seating capacity
- Lowest seat mile cost
- Automatic stabilization
- Instrument flight capability

For detailed information write: Customer Relations Manager

VERTOL Aircraft Corporation

MORTON, PENNSYLVANIA




THE 5-POINT BILL OF PARTICULARS

FOR Ampli-NYL *

*** the entirely new insulated A-MP terminal for large wire sizes**

- High Performance Nylon Insulation to provide continued satisfactory service life at elevated temperatures, plus resistance to ester-based oils.
- Helical tongue design to secure maximum structural utility at minimum weight penalty.
- Cast insulation has formed entry ramp to provide easy wire insertion and snug fit over standard AN wires.
- Color-coding to assure proper terminal selection for applicable wire sizes.
- Step-Lok Crimp to guarantee continued proper position of insulation with respect to terminal.

The A-MP Ampli-NYL Terminal is installed with the proven Confined "C" Crimp for maximum electrical and mechanical performance. Confining the spread of the terminal during the crimping process achieves more intimate contact and a homogeneous union of conductor and terminal.

Additional information is available on request.

**AMP INCORPORATED**

**GENERAL OFFICES:**

**1204 Eisenhower Boulevard, Harrisburg, Pa.**

Wholly Owned Subsidiaries: Aircraft-Marine Products of Canada Ltd., Toronto, Canada • Aircraft-Marine Products (Great Britain) Ltd., London, England • Societe AMP de France, Le Pre St. Gervais, Seine, France • AMP—Holland N.V. 's-Hertogenbosch, Holland

Japanese Distributor: Oriental Terminal Products Co., Ltd., Tokyo, Japan.

of something like 20,000 U. S. gallons of fuel, the CL-28 can be fueled by the mobile cart in about 18 min. Unit was designed by Canadair in conjunction with the W. R. Dand Petroleum Equipment and Gorman-Rupp Pump Companies.

**New plastic** air scoop cover for FJ-4 Fury Navy fighters is being produced by Westerville, O., Industries. Cover is made by vacuum-forming process which shapes cover and handle in a single operation. Unit is made from

"Seilon," a polyvinyl chloride developed by Seiberling Rubber Co. Seiberling says new covers are more durable and less costly than previously-used wood or plastic covers. New units also have good resistance to temperature extremes. Covers are used at North American Aviation's Columbus, O., plant.

## WHAT'S NEW

### Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

**Minutes of Physical Metallurgy Symposium**—by Ordnance Corps, U. S. Army: $2.00; 72pp.; (PB 131105).

**Permanent-Magnet Generators, Part 1—Theory**—by D. S. Toffolo and D. J. Hanrahan, Naval Research Laboratory, March 1957: $.50; 18pp.; (PB 121862).

**Permanent-Magnet Generators, Part 2—Design Consideration**—by D. S. Toffolo and D. J. Hanrahan, Naval Research Laboratory, May 1957: $.75; 27pp.; (PB121946).

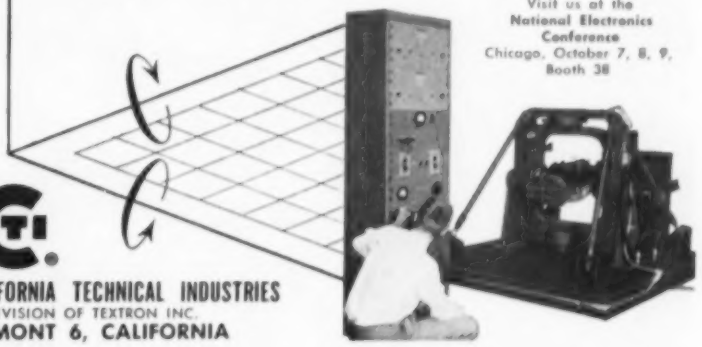

**THREE-AXIS FLIGHT SIMULATOR**

Providing a flight table which can be continuously oriented in space with respect to three mutually-perpendicular reference axes, the CTI Dynamic Flight Simulator can be programmed directly from the output of a computer. Operating smoothly with no gearing, the instrument accepts independent voltage signals in each of the 3 axes and converts these vector analogs into a position corresponding to the defined space vector.

By thus reproducing the conditions of an actual high-performance aircraft or missile in flight, the unit expands the capabilities of any laboratory.

*Write for brochure*

Visit us at the National Electronics Conference Chicago, October 7, 8, 9, Booth 38



CTI

CALIFORNIA TECHNICAL INDUSTRIES
DIVISION OF TEXTRON INC.
BELMONT 6, CALIFORNIA

**TRANSDUCERS**
for
**ABSOLUTE, DIFFERENTIAL or GAGE PRESSURES**

Outputs linear with pressure, pressure altitude and air speed.

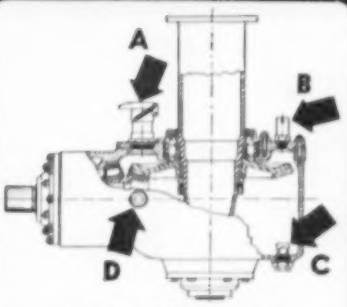
For Recording, Control and Indicating in Industry.

Write for complete technical information

**COLVIN LABORATORIES, INC.**
364 Glenwood Avenue, East Orange, N. J.
35 N. Arroyo Parkway, Pasadena 1, Calif.

Electro-mechanical instrumentation for aircraft, missiles, and industry

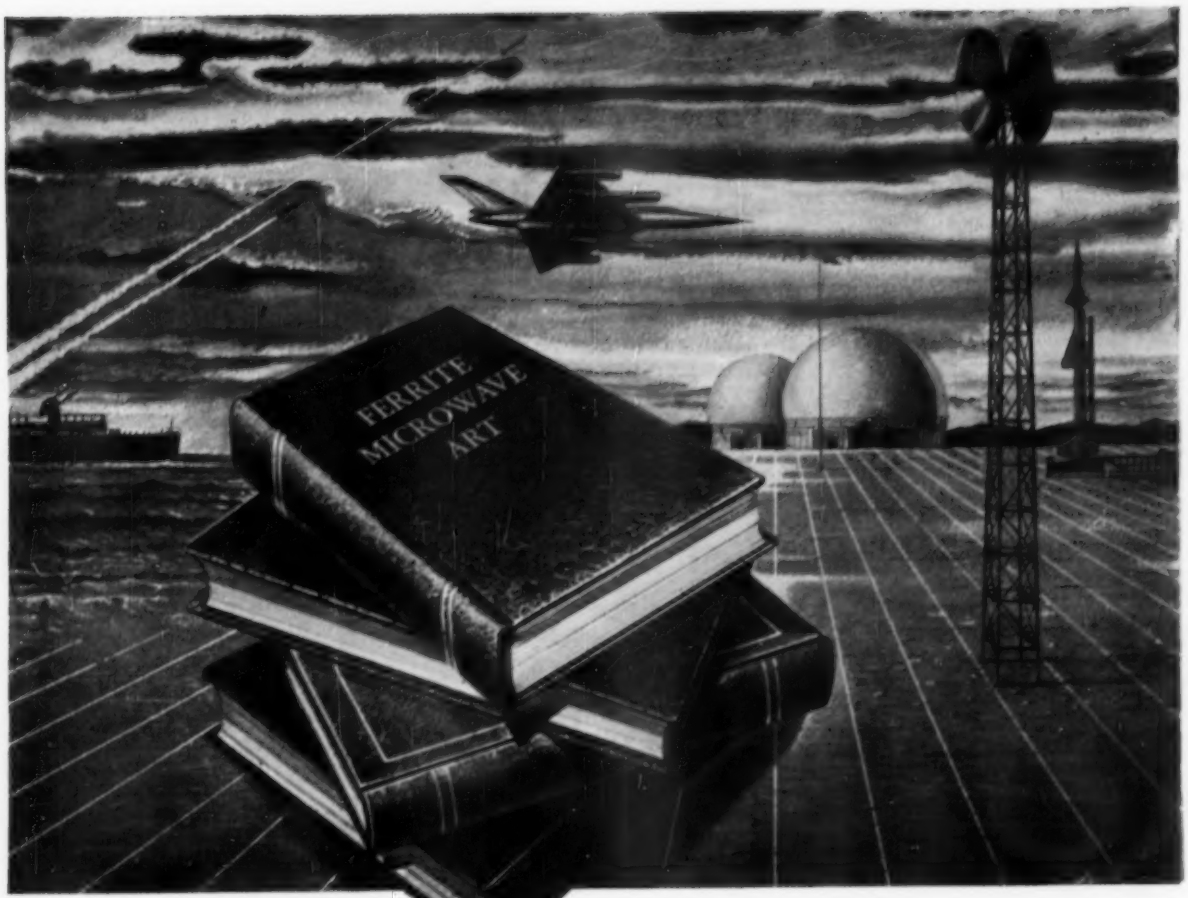
**AIRCRAFT GEAR CASE ACCESSORIES**




**A—TEDECO FILLER CAP**
**B—TEDECO BREATHER VENT**
**C—TEDECO SELF-CLOSING DRAIN PLUG**
**D—TEDECO OIL JET**

This line of accessories eliminates the need for adapting general manufacturers' equipment to aircraft requirements. Tedeco Gear Case Accessories are designed and manufactured to meet all military and commercial aeronautical specifications. Send for our catalog.

**TECHNICAL DEVELOPMENT CO.**
305 South Chester Pike, Glenolden, Pa.




Airtron inc.

# ferrite advances add new chapters to the microwave art

**KITTLESON COMPANY**
Albuquerque
210 Cagua Drive, N.E.
Albuquerque, N. M.
Albuquerque 6-6987
San Francisco
809 San Antonio Rd.
Palo Alto, Calif.
Davenport 6-7410
Denver
1460 Pennsylvania St.
Room 7
Denver 3, Colorado
Alpine 5-2777
Hollywood
416 North LaBrea Ave.
Hollywood, California
Webster 3-7371

**ARVA CORP.**
Seattle
120 West Thomas St.
Seattle 99, Wash.
Murdock 7337

**JACK F. McKINNEY SALES CO.**
Dallas
1330 North
Industrial Blvd.
Dallas, Texas
Riverside 1368

Since the close of World War II the big push has been toward the use of higher and higher frequencies to solve the many problems which threatened to limit modes and extent of radio communication as well as radar and other detection systems.

From LF to HF to VHF to UHF and beyond — from the 50 kilocycles radio band to the 10,000 megacycle weather radar is the distance we have traveled in the past fifteen years. Today our sights are set on the 30,000 to 90,000 megacycle bands.

Airtron, Inc. has been a leading contributor to the extension of the microwave state of the art. It has been Airtron who has written in the **new chapters** on ferrite components and material, double ridge waveguides, and high powered, miniature ferrite and non-ferrite microwave components, to the standard texts that are the only reference source for engineers and users of microwave equipment.

Industry's pressing need for non-reciprocal microwave components demanded applications for which there was no readily available theory, or reference source. With Airtron, Inc. it has been the application of **practical theory** that has **stamped solved** many of these new microwave **ferrite design problems.** The end results have been quality production items — some of which are in use today in every weather radar system — electronic devices operating with ferrite components — miniature ferrite isolators and duplexers — high powered ferrite components and special designs still under the wraps of security.

Today — there is only ONE organization which can offer you the complete range of microwave engineering and equipment . . . only one company which can point to the advances of the past decade in the microwave and ferrite art as being almost wholly its own . . . This is Airtron, Inc. creative leaders in the Microwave Art.

SEE US AT BOOTH 2822

Airtron inc.

LINDEN, NEW JERSEY — AIRTRON CAMBRIDGE (FERRITE DIV.), CAMBRIDGE, MASSACHUSETTS

FOREIGN AFFILIATES
AIRTRON CANADA, LTD., TORONTO, CANADA | W. H. SANDERS (ELECTRONICS) LTD., STEVENAGE HERTS, ENGLAND | SIVERS LAB., HAGERSTEN, SWEDEN

# CAA Contracts

Washington—Following is a list of contracts as released by the Civil Aeronautics Administration:

**Maryland Electronic Manufacturing Corp.**, College Park, Md., $463,125.46 for glide slope projectors and associated equipment.

**General Electric Co.**, Syracuse, N. Y., $175,653 for providing and installing moving target indicators (MTI) on five long range radar installations.

**Collins Radio Co.**, Cedar Rapids, Iowa, $84,177.16 for very high frequency (VHF) transmitters and spare parts.

**White Plains Electrical Supply Co.**, White Plains, N. Y., $34,876 for transformers.

**Nems-Clarke Inc.**, Silver Spring, Md., $31,245 for control units.

**Teletype Corp.**, Chicago, $22,838.98 for teletypewriter equipment.

**Collins Radio Co.**, Cedar Rapids, Iowa, $15,590.76 for an automatic pilot for installation in a DC-3 type aircraft.

# Army Contracts

Washington—Following is a list of unclassified contracts for $25,000 and over as released by Army Contracting Offices:

**U. S. ARMY ENGINEER DISTRICT, SEATTLE, Corps of Engineers, Seattle, Wash.**

**J. G. Watts Construction Co.**, Salem, Ore., TM site 179, Kalispell, Mont., Contract DA-45-108-ENG-4202 (IFB ENG-45-108-57-58), $2,513,746.

**PICATINNY ARSENAL, Dover, Del.**

**Industrial Metal Fabricating Co. Inc.**, Clifton, N. J., A: Handling cradle assembly for adaption kit, warhead, rocket, MX79; B: Alignment fixture 7 ea, (IFB N-6889), $39,480.

**PHILADELPHIA ORDNANCE DISTRICT, Philadelphia, Pa.**

**Aircraft Armaments Inc.**, Cockeysville, Md., development and supply of cartridge, actuated canopy remover for F-106A aircraft, DA-36-034-ORD-128, $128,820.

**Virginia Polytechnic Institute**, Blacksburg, Va., research study to develop methods for analysis and evaluation of defect data on Redstone missile system, DA-36-034-ORD-2531, $35,556.

**OFFICE OF THE DISTRICT ENGINEER, Jacksonville District, Jacksonville, Fla.**

**Albert Thompson Construction Co.**, Tampa, Fla., construction of electric supply, emergency and electric supply, primary, (FY-57), MacDill AFB, Tampa, (INV. No., ENG-08-123-57-50), $153,963.

**ENGINEER DISTRICT, Corps of Engineers, Detroit.**

**Champion Inc.**, Iron Mountain, Mich., construction of aircraft shelters, including all related work necessary and pertaining thereto at Kinross AFB, Kinross, Mich., (IFB ENG-20-064-58-2), $147,100.

**Roth, Wadkins and Wise Inc.**, Detroit, Mich., construction of aircraft shelters, including all related work necessary and pertaining thereto at Selfridge AFB, Mich., (IFB ENG-20-064-58-3), $232,350.

**Summit Construction Inc.**, Lansing, Mich., construction of aircraft shelters, including all related work necessary and pertaining thereto at Wurtsmith AFB, Oscoda, Mich., (IFB ENG-20-064-58-6), $259,200.

**REDSTONE ARSENAL, Huntsville, Ala.**

**Thiokol Chemical Corp.**, Trenton, N. J., continued development of 18 (Falcon) rocket engines, $298,561.

**The Brush Beryllium Co.**, Cleveland, rod, round, beryllium, QMV, commercially pure grade, (Purchase request: ME-20277-57), $62,445.

**Tennessee Valley Authority**, Chattanooga, Tenn., electrical energy for period, July 1, 1957, through July 31, 1957, (Purchase request: Delivery order against contract No. DA-01-021-ORD-4587), $37,490.

**Thiokol Chemical Corp.**, Trenton, N. J., design and development of solid propellant Vernier engine, $49,978.

**Thiokol Chemical Corp.**, Trenton, N. J., development, manufacture and delivery of TX62 and XM10 rocket engines, (Purchase request: CH-6-8), $122,482.

**Tube Distributors Co. Inc.**, 1415 Kellum Pl., Garden City, N. Y. Tubing steel, corrosion resistant, (18-8 stabilized), type 347, seamless, annealed, in 20 ft. random lengths, according to MIL-T-8606 (ASG), purchase request ME 19655-57, $42,842.

**ARMY ORDNANCE DISTRICT, Pasadena, Calif.**

**Douglas Aircraft Corp.**, Santa Monica, Calif., supplies and services relating to the Honest John missile, $40,000.

**Radioplane Co.**, Van Nuys, Calif., instruction and maintenance relative to target drone, $49,982.

**Gilfillan Bros.**, Los Angeles, field engineering services relating to ground guidance equipment for the Corporal missile, $404,745.

**Firestone Tire and Rubber Co.**, Los Angeles, technical representative for the Ordnance Guided Missile School, $31,858.

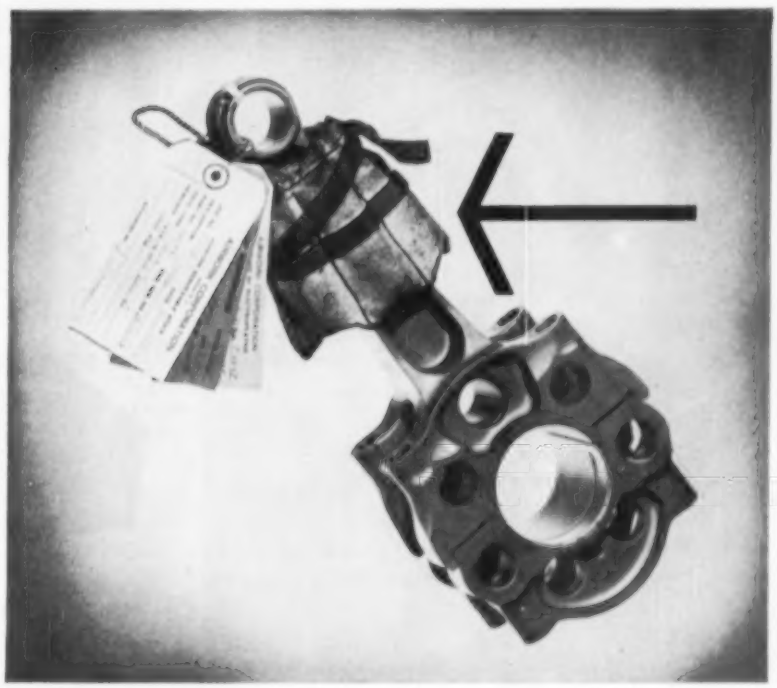
**Douglas Aircraft Co.**, Santa Monica, missile technical representative services, $48,972.

**SIGNAL SUPPLY AGENCY, Philadelphia, Pa.**

**TRG Inc.**, New York, N. Y., services, facilities and materials for nine months research investigations leading to optimum design of missile, air and submarine borne Cesium Beam frequency standard, contract No. 73283(P. D. No. 58-ELS/R-3533), $155,000.

**ARMY ENGINEER DISTRICT, Little Rock, Ark.**

**Ben M. Hogan & Co.**, Little Rock, construction of dual access road, Little Rock AFB, (IFB ENG-03-050-57-53B), $193,175.

## Why Should An Inspector Do This?

Because the correct fit of link pins to a master rod is a high precision job. Only a difference of 0.0003" in diameter makes the difference between a pin that fits correctly, and one that doesn't!

At Airwork, 54 different diameters of link pins are needed to correctly fit master rods on just one popular engine. Naturally, it takes an inspector, equipped with the best of precision gauges to select the pins that fit exactly.

Those pouches keep pins and the mating rod together; protecting the pins until they reach final assembly. This is just one more Airwork procedure that helps produce a longer lasting trouble-free engine.

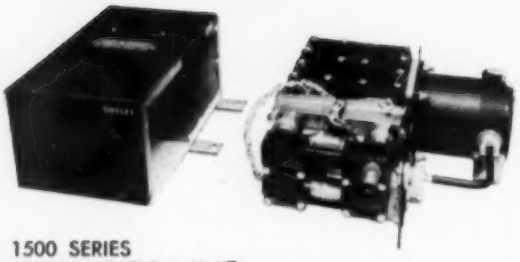
Airwork CORPORATION
Millville, New Jersey

BRANCHES IN:
WASHINGTON
NEWARK • MIAMI • ATLANTA
CLEVELAND

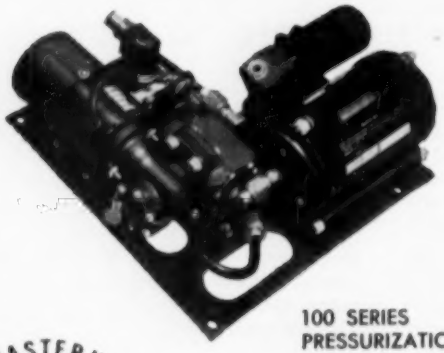
# PRESSURIZING AVIONIC SYSTEMS

Eastern pressurization equipment protects vital electronic gear. A continual program of research and development creates customized pressurization units that keep the performance of avionic systems unaffected by altitude and ambient conditions. Custom units that *meet military specifications* help to solve your problems when recommending electronic components.

When you have a challenging problem to prevent pressure, or heat, or moisture, or dust from affecting electronic performance, come to Eastern for complete and creative engineering help.



1500 SERIES
PRESSURIZATION UNIT



100 SERIES
PRESSURIZATION UNIT

**EASTERN PRESSURIZATION UNITS**

A variety of capacities accommodates a broad range of requirements and meets appropriate government standards. Typical units operate from zero to over 70,000 feet at temperatures from —65°F to +160°F. Delivery: 0-3600 cu. in./min. free delivery, Discharge Pressure: 0-60 p.s.i. Standard sub-assemblies and components normally are used to create a custom-made design to fit your exact needs. Units may consist of an air pump and motor assembly, pressure switch, check valve, tank valve, terminal connectors, and dehydrator.

Write for Eastern AVIONICS BULLETIN 340

EASTERN AVIATION PRODUCTS

**Eastern INDUSTRIES, INC.**
100 Skiff St., Hamden 14, Conn.

West Coast Office: 1608 Centinela Avenue
Inglewood 3, California — Phone ORegon 8-3958

# Colonial Preparing Four-Seat Amphibian

**Millville, N. J.**—First details of Colonial Aircraft Corp.'s new four-passenger amphibian, called the Model C-2 Sportsman, were recently given to AVIATION WEEK by the company's president, David Thurston.

Prototype is nearing completion at Colonial Aircraft's plant at Sanford, Me.

It is scheduled for delivery to a Chicago distributor, National Aero Sales Corp., during October. Plane's type certificate, which is a revision of the type certificate currently in force for Colonial's three-place C-1 Skimmer, is now pending.

The Sportsman will be almost a carbon copy of the Skimmer in dimensions and external appearance. Hull length (23 ft. 6 in.) and wing span (34 ft.) will be identical.

Principal difference will be a switch from the 150 hp. Model 0-320 Lycoming engine which powers the Skimmer to a 180 hp. Model 0-360 Lycoming for the Sportsman. Power increase will allow the plane's weight to go up 200 lb. from 2,150 lb. to 2,350 lb. Because the greater weight will make the airplane sit lower in the water, fixed wing tip floats will be shortened two inches each.

Price of the four-seater will be $19,850 FAF Sanford, Me. New price of the three-seater is $17,750. Both prices include sensitive altimeter and rate-of-climb indicator.

### Demonstration Flight

A demonstration flight in the Skimmer, which included take-offs and landings on both land and water, gave these impressions:

- **Ground handling** characteristics are good because of the tricycle landing gear configuration, aided by wide tread of main gear and relatively long wheel base between nose and main gears.
- **Water handling excellent.** Amphibian can make a reasonably sharp turn while riding on its step at 50 mph. (indicated). This gives the plane good short water takeoff potential since it can run downwind until it gets on its step at about 50 mph., then can make a 180 deg. turn into the wind for takeoff, making for very short total run. Such a maneuver is not possible with a float-type aircraft.
- **Water rudder** makes plane easy to handle in the water at low speeds.
- **Hull design keeps** windshield and side windows almost completely free from spray during water operation, allowing the pilot full visibility at all times.
- **Noise from the** pusher engine is about average for a single-engine private plane.

### Stretched to Four Seats

Main change in the interior of the shoulder-wing amphibian is that the Sportsman's instrument panel and pilot's and co-pilot's seats have been moved forward eight inches. In place of the side-facing jump seat installed behind the pilot in the Skimmer, Colonial has added a full-width couch-type seat in the Sportsman that is capable of comfortably seating two large men.

Behind the seat will be baggage storage space located on the plane's center of gravity.

The Sportsman can quickly be converted to a utility plane by removing the rear and co-pilot's seats. In this configuration, plane can accommodate bulky cargo such as pipe in lengths up to 12 ft. and heavy cargo up to 930 lb.

Other Sportsman specifications are:

- **Weights**—weight empty, 1,450 lb.; useful load, 930 lb.; normal fuel weight (40 gal.), 240 lb.; gross weight, 2,350 lb.
- **Propeller**—Hartzell forged dural, constant speed.
- **Performance**—stalling speed, 52 mph.; cruising speed, up to 135 mph.; sea level climb, 800 fpm.; range, 500 miles.

Second Sportsman will be ready for delivery by December. Current plans are to build the amphibian at a one-a-month rate at least through April, 1958.

Future construction will depend on orders.

Colonial will also build at least five more Skimmers interspersed with the Sportsman. Future of the three-seater is indefinite and will depend on orders. "We will play Skimmer production by ear," said Thurston.

## North America's Civil Copter Fleet Near 400

More than 380 helicopters are being operated by 89 commercial rotary wing operators in North America, a survey by Aircraft Industry Assn.'s Helicopter Council shows. Some 50% of these operators are using one or two helicopters. The largest, Okanagan Helicopters, Ltd., Vancouver, B. C., is using a fleet of 25 Bell 47s, 17 Sikorsky S-55s, 1 S-58.

According to available data, the 89 North American operators fleet breakdown is as follows: Approximately 274 Bell Model 47s, 2 Sikorsky S-51s, 51 S-55s, 14 S-58s, 25 Hiller 12s, 5 Vertol HRPS and 9 H-21s.

## Army to Test L-19A Amphibian

Cessna L-19A fitted with Edo Model 339-2250 amphibious floats will be evaluated by U. S. Army's Aviation Board for Continental Army Command. Plane is shown just before leaving New York for flight to Ft. Rucker where flight test program will be carried out. Auxiliary fins were added to tail to counteract side area of floats.

**The Grumman F11F-1F "Tiger"** is the most advanced version of the Navy's supersonic F11F. Powered by the mighty J-79 turbojet engine with afterburner, the swept-wing fighter has shown a "marked increment in speed" over the earlier "Tiger".

# How fast? How high?

## "Pinch waist" design and efficient turbojet of the "Tiger" indicate superior supersonic performance

Unofficially, the F11F-1F "Tiger" has topped the world's altitude and speed records.

Credit this boost in supersonic performance to design concepts like the "area rule" and to the use of a new and more powerful turbojet – the J-79.

Nickel alloys can take part of the credit too. Incoloy "T" (nickel-iron-chromium alloy) for example, is used to line the combustion chambers. In this service it provides a combination of extremely useful properties: excellent heat and corrosion resistance . . . strength and ductility. What's more, Incoloy "T" alloy is a material that's readily fabricated.

Perhaps the properties of Inco Nickel or one of the Inco Nickel Alloys can improve your product. Why not investigate the possibility by telling us your requirements. Just write to Inco's Mechanical Engineering Section. The address is below.

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street New York 5, N. Y.

**INCO Nickel Alloys**

*are marketed under the following trademarks:*

MONEL • "R" MONEL • "K" MONEL • "KR" MONEL "S" MONEL • INCONEL • INCONEL "X" • INCONEL "W" • INCONEL "700" • INCOLOY • INCOLOY "T" INCOLOY "901" • NIMONIC Alloys

Where Inco Nickel Alloys are used in jet aircraft

**Inconel**
Combustion liners
Transition sections
Insulating blankets
Lock wire and rivets
Fuel line tubing

**Inconel "X"**
Rotor discs
Afterburner bellows
High-temperature bolts
Rocket engine rotors

**Nimonic Alloys**
Combustion liners
Transition sections
Vaporizer tubes
Turbine blades
Rotor discs

**Inconel "W"**
Tail cones
Afterburners

**Inconel "700"**
Turbine blades

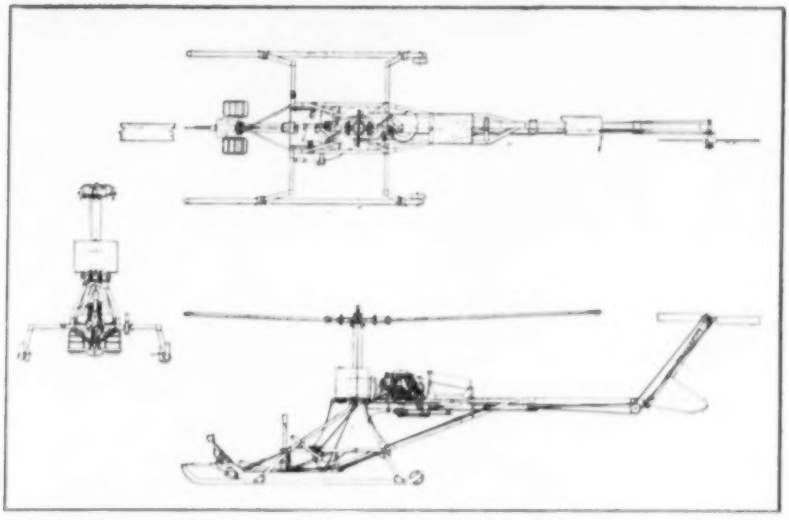
**Incoloy "T"**
Transition sections
Combustion liners

**Incoloy "901"**
Turbine discs

**Monel**
Lock wire
Fine fuel line tubing
Rivets

**"S" Monel**
Ball bearing retainer rings

Pure Nickel for electrical and electronic gear. Primary Nickel as alloying element in other materials. Inco Precision Castings in many different alloys.



**GOODYEAR AIRCRAFT** one-man helicopter is powered by 35-hp. two-cycle watercooled engine. Airframe of craft is welded aluminum alloy supported by steel outrigger tubes.

# 1-Man Helicopter Grosses 490 lb.

Third version of Goodyear Aircraft Corp.'s ultra-light one-man helicopter, Model GA-400R-3J, is intended as a production configuration. Extensive development with two previous "Gizmo" prototypes has resulted in changes in fuselage configuration, lowering the fuel tank and powerplant, lengthening the main rotor mast and repositioning and reshaping the tail fin.

Airframe of welded aluminum alloy tubing is supported by steel outrigger tubes to which the skid-type landing gear is attached. Powerplant is a 35-hp. two-cycle watercooled Outboard Marine & Manufacturing Co. RDHE, which gives the "Gizmo" a top speed of 55 kt., normal cruise speed of 40 kt. and vertical climb rate of 400 fpm.

Hovering ceiling is 4,000 ft. and endurance at cruise speed is 45 min. allowing 10% fuel reserve.

Main rotor is balanced about the feathering axes mounted in an aluminum hub underslung from a teetering hinge.

Main rotor is driven at a 10:1 reduction ratio. Formed sheet aluminum tail rotor operates on a 2:1 reduction ratio using V-belts.

Basic GA-400R-3J characteristics: main rotor diameter, 20 ft.; main rotor disk area, 314 sq. ft.; disk loading, 1.52/lb./sq. ft.; overall length (not including rotors), 18 ft. 4 in.; maximum height, 6 ft. Gross weight is 490 lb.; empty weight is 290 lb. Fuel capacity is four gallons.


*With A*

*Watchmaker's Precision*

Every aviation service, whether it be at the engine overhaul facilities of Dallas Airmotive in Dallas or at the Company's complete fixed base operation at its Island Service Division in Galveston, is performed with the precision of a watchmaker.

These services are many and varied. Dallas Airmotive continues to be the nation's leader in the overhaul of airplane engines at its extensive Dallas plant.

At Galveston, practically every other service for the airplane operator is available. The Island Service Division performs all types of modification, painting, radio-electronics — navigation sales and installation, overhaul for conventional planes and helicopters, and accessory sales, service and installation.

All services — with the precision of a watchmaker.

*Island Service Division*

GALVESTON, TEXAS

DALLAS AIRMOTIVE

6114 FOREST PARK ROAD

FLEETWOOD 1-3771 • DALLAS, TEXAS

*Washington Office* Woodward Building 733 15th Street, N.W. Washington, D.C.

*New York Office* 1219 Marine Terminal Bldg. La Guardia Station Flushing 71, N. Y.

# 433 AMERICAN FLIGHTS PER DAY RELY ON SINCLAIR...

Every day, more than 23,000 persons board approximately 433 American Airlines flights, many of which are American's famed Mercury flights utilizing 365-mile-an-hour DC-7 Flagships.

All American Airlines flights are lubricated with Sinclair Aircraft Oil. In fact, American Airlines has relied exclusively on Sinclair Aircraft Oils for 23 years. This, plus the fact that 45% of the aircraft oil used by major scheduled airlines in the U.S. is supplied by Sinclair, is a tribute to Sinclair reliability.

## SINCLAIR AIRCRAFT OILS

Sinclair Refining Co., Aviation Sales, 600 Fifth Ave., New York 20, N. Y.

# PRIVATE LINES

**Aircraft components** manufacturing firm led by James Hurst will occupy a new 3,000-sq.-ft. facility at Phoenix, Ariz. Arizona Aircraft (Azair) plans to eventually build new aircraft. Initially it will make lightweight aircraft furnishings, airframe assemblies, electrical system components and develop modifications aimed at improving performance.

**Waiting list** for hangar space was established prior to recent opening of new business and private plane facilities at Metropolitan Oakland International Airport, Calif. Included are 16 T-hangars, four larger hangars with shop space and four executive plane structures. A plane washing section is included. Area is planned for further expansion; some 300 hangars can be erected in the facility if required. Initial units were built at cost of $189,940 with part of proceeds coming from sale of $3.4 million in revenue bonds.

**Major price reductions** of $100 to $200 were made by Safe Flight Instrument Corp. on its speed control equipment. Model SC-24 for multi-engine aircraft was cut from $695 to $495; SC-12 for single-engine planes was reduced from $345 to $245. . . . SFI delivered its 40,001st stall warning indicator (to Cessna for installation on a 310). Detector is now standard equipment on Cessna, Beech, Aero Design and Mooney aircraft, the firm notes.

**Advancement into civil aviation** modification and repair work is underway by Land-Air, Inc., with recognition by Civil Aeronautics Administration of firm's Cheyenne Division as a certified repair station covering unlimited airframe (Class I, II, III and IV) and radio (Class I) with limited navigation. Division, occupying 195,000-sq.-ft. facility at Cheyenne Municipal Airport, hitherto specialized in military contracts for prototype engineering and installation of electronic equipment in military planes.

**Bids for fixed base operations** concession at Detroit (Mich.) Metropolitan Wayne County Airport will be received Oct. 21 by county's Board of County Road Commissioners.

**Export of 250 airplanes** was made by Cessna Aircraft Co. to 28 different countries in the first six months of 1957, a new record for the firm. Biggest market continued to be Central and South America, which accounted for 201 airplanes. Total breakdown by model exported: 36 Model 170s, 58 Model 172s, 69 Model 180s; 68

## Roadable Plane Tested on West Coast

Three-place Aerobile undergoing flight tests in California is basically revived, modernized version of prewar Waterman Arrowbile designed to meet Dept. of Commerce competition for "safe $700 airplane" in the mid-1930s. New version pictured above has a 160-hp. Tucker engine, ethyl-glycol cooled. Aerobile has a top speed of 135 mph. and cruises at 115 mph., designer Waldo Waterman reports. Top photo shows V-struts unpinned from fuselage, the wing raised from the fuselage by an electrical actuator operating off plane's battery. Wing is supported off ground by struts, permitting car to be driven away (center photo). Control system uses matching cranks at wing and fuselage junctions to eliminate need for manually disconnecting controls. Car portion weighs under 1,400 lb., cruises at 55 mph. It has been driven at more than 70 mph., Waterman states. It is licensed as a motorcycle.

# Rohr *engineers are*

# busy building

## *tomorrow's great airliners today...*

Rohr is eager to maintain its top position in aircraft components . . . and desires to talk to aircraft engineers who are eager to help build power packages and other major components for America's great new airliners of the future.

Rohr's quarter-billion backlog is over *50% commercial*. This, of course, means real security along with top industry salaries and career opportunities in the nation's finest living area. Experienced design and stress engineers are invited to write Rohr now. We'll arrange personal interviews at mutual convenience.

World's Largest Producer of Ready-To-Install Power Packages for Airplanes

ROHR AIRCRAFT CORPORATION

Address: J. L. Hobel, Industrial Relations Manager, Rohr Aircraft Corp., Chula Vista, California, Dept. 45

Chula Vista and Riverside, Calif.

## 'Shock Absorber' Fitted to Wings

**Air-hydraulic cylinder at fuselage side of each wing strut terminus of specially modified Taylorcraft BC-12D permits wings to flex in bumpy air, providing smoother and more stable flight, according to Earl G. Metzler, who developed the novel shock absorbing system (AW Sept. 30, p. 116). Cylinder permits the wings to flex a maximum of almost three feet at the tips; normal movement in the air is about one foot.**

Model 182s and 19 Model 310s. . . . Total exports by all U. S. business and private plane makers for the first half of 1957 were 665 airplanes valued at $10,011,678, an increase of 85% in value and 45% in units over the same period of 1956.

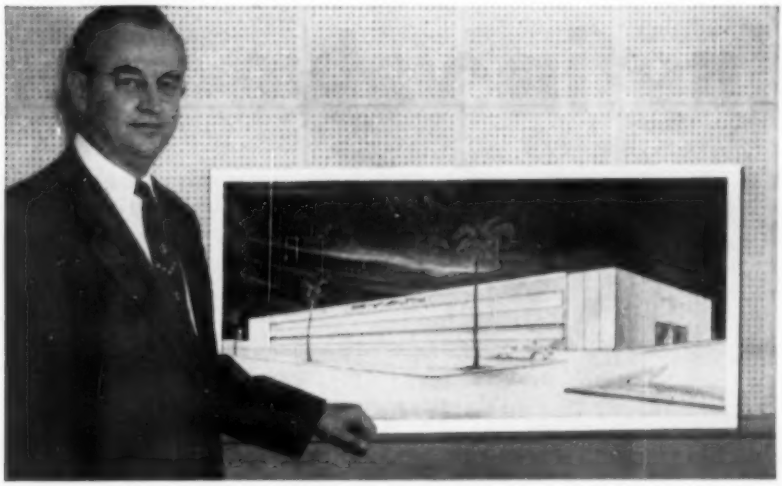
**Sales of $4,168,764** for August are reported for 29 members of Aviation Distributors and Manufacturers Assn., up 9.26% over the same month last year. First eight months' sales by ADMA members are up 16.78% compared with the same period last year.

**Recent Hiller 12-C helicopter sales** to five foreign countries included: two to Fison-Airwork, Ltd., which is using them for spraying banana plantations in Panama; one de luxe model to Sociedad Agricola & Industrial, Guayaquil, Ecuador, for agricultural and transport work; a custom 12-C for a dealer in Buenos Aires; one for Helicopter Services, Ltd., New Zealand, for aerial top dressing and one to Black & Ross Construction Co., Vancouver, B. C., for support of highway building.

(Advertisement)

## REPORT FROM RYAN

# New Engineering Opportunities Created as Ryan Projects Mushroom



**FRANK W. FINK, RYAN VICE PRESIDENT AND CHIEF ENGINEER** inspects architect's drawing of new Engineering and Research Center.

## New Engineering and Research Center To Meet Ryan's Expansion

Construction of a modern two-story, engineering and laboratories building has begun at Ryan, to meet the company's expanding work in Jet VTOL—Automatic Navigation—Jet Drones—Missile Guidance—Jet Metallurgy—Rockets.

The new facility will provide additional quarters for many of the 1000 employees in Ryan's fast-growing engineering division. It will also house complex, new chemical, metallurgical, instrumentation, environmental and autopilot equipment.

With one in six Ryan employees in engineering, this division has tripled in three years. Its mushrooming growth reflects Ryan's increased importance as a research facility in aerodynamics, propulsion and electronics.

**RYAN ENGINEER** "zooms" straight up in unique rotatable cockpit.

## Vertical Flight Probed with New VTOL Cockpit

Shortest way into the sky is straight up—in the Ryan Vertijet. To probe this new realm of flight without becoming airborne is a trick performed daily by Ryan engineers. Their secret? A rotatable cockpit connected with electronic computers.

Ryan's flight simulation laboratory is a prime tool in the test of new aircraft designs. Both the Vertijet and the subsonic, turboprop-driven Vertiplane are put through their paces via earthbound flight test. Ryan leadership in this revolutionary new concept of flight is based upon 2¼ million manhours of VTOL research and development. It is another example of how Ryan builds better.

## Ryan Automatic Navigator Guides Global Flight

An advanced system of aerial navigation, designed for high speed, long range flight, has been developed by Ryan electronics engineers, working under sponsorship of the Navy's Bureau of Aeronautics.

Designated AN/APN-67, the new navigator is the lightest, most compact, self-contained electronic navigator in production. Developed to meet military needs, it will also meet commercial jet flight requirements.

The system provides pilots and navigators with continuous information on longitude, ground speed, ground mileage, drift angle and ground track. It is accurate and instantaneous. Requires no computations, ground facilities or wind data.

**AUTOMATIC NAVIGATOR** guides pilots with single instrument (above).

### Ryan has immediate career openings for engineers

Look to the future. Look to Ryan . . . where you can grow with an aggressive, forward-looking company. You'll find a variety of stimulating projects. Ryan engages in all three elements of modern flight vehicles—airframes, engines to propel them and electronics equipment to guide them.

Send today for Ryan's brochure, "Engineering Opportunities". Mail this coupon to:

Mr. James Kerns, Engineering Personnel
Ryan Aeronautical Company
Lindbergh Field, 2736 Harbor Drive
San Diego 12, California

NAME

ADDRESS

PHONE NO.

DEGREE SCHOOL

FIELD OF EXPERIENCE OR PREFERENCE

*From Whittaker's Fuel Division:*

# 3-inch plug-in valve that

Whittaker's 3-inch plug in valve is standard on all new Lockheed Model 1649A's. Because the body and actuator can be removed quickly and easily without opening the tank or disturbing the tank and line seals, it has been estimated that at least 90% of maintenance time can be saved.

In the Lockheed Model 1649A, TWA Jetstream,* the new Whittaker gate type plug-in valve reduces ground time and expense during valve inspection to a high degree.

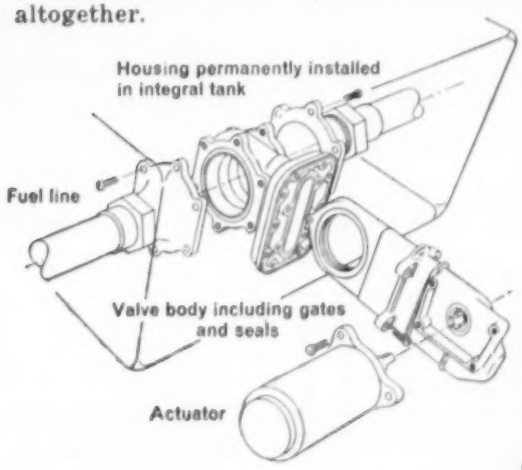
# cuts service time by 90%

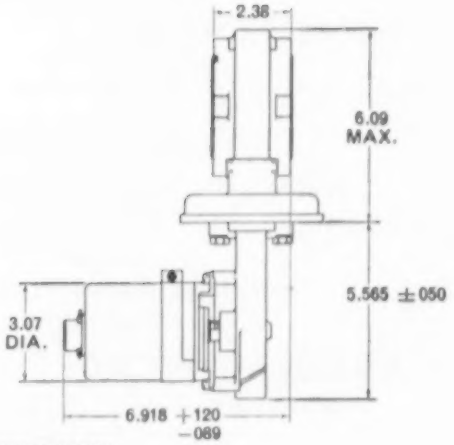
Installed now in Lockheed's remarkable new Model 1649A, Whittaker's gate type plug-in valve permits removal, inspection and replacement without opening the tank or disturbing the tank or line seals.

This unit consists of an integral housing (permanently attached to fuel tank structure and plumbing), and valve body assembly including valve gate, gate seals, and body. This assembly is removable from the fixed housing.

The actuator in this valve can be replaced without leakage with the adjacent plumbing filled with fluid.

The AC or DC electric motor actuator, mounted on the valve body, can be removed individually or the actuator and body can be removed altogether.




**PERFORMANCE**

SERVICE. Aromatic and jet fuels
MOUNTING. Mounting flange grooved for MS29513-252 and MS29513-149 "O" ring packings
PRESSURE. Rated operating pressure 15 PSIG Max.
TEMPERATURE. Ambient, −65°F to +160°F
Fluid, −65°F to +135°F
TEST PROCEDURE NO. 116306
TIME. Operating at 26 volts and 70°F:
Open – 1 second
Close – 1 second

**ELECTRICAL DATA**

18 to 30 volt D.C. motor
AN3102E-16S-1P Receptacle provided
Pin "A" energized to open valve
Pin "B" energized to close valve
Pin "C" internally connected to Pin "D" in full open position
Pin "F" internally connected to Pin "G" in full closed position
Pin "E" common return for Pins "A" and "B"
Stall current 5.0 Amps. Max @ 26 volts and 70°F

**SEND THIS COUPON FOR COMPLETE INFORMATION**

**Wm. R. Whittaker Co., Ltd.** **Dept. 356**
**915 N. Citrus Avenue • Los Angeles 38, Calif.**

Gentlemen: Please send me further information on the Whittaker 3-inch gate type Plug-in Shut-off Valve (P/N116305)

Name_____
Company_____
Address_____
City_____ Zone____ State____

Whittaker

CONTROL SYSTEMS
Fuel • Hydraulic • Pneumatic

Los Angeles • Seattle • Wichita
Indianapolis • Baltimore
Hempstead, Long Island

*Jetstream is a service mark owned exclusively by TWA

# REGIONAL EXPORT SALES MANAGER

**Needed immediately at Cessna to cover Near East, Africa and Europe.**

- Knowledge of all or part of above areas is essential
- Must be experienced in Sales and Distribution Management.
- Previous aviation experience desired.
- Will headquarter in Wichita temporarily.

Cessna

Designers and Manufacturers of a complete line of Business Aircraft.

**Contact**
**Professional Placement Supervisor,**
**Dept. AW,**

**CESSNA AIRCRAFT COMPANY**
**5800 East Pawnee Road, Wichita, Kansas**

## Mechanical Design Engineers

# $8,000.00

## and it's your move . . .

**You start well and soon do even better if you have the ability to break new ground in the field of small gas turbine engines.**

**The basic ideas are what we want from you. Skilled draftsman will handle the finished drawings.**

**Your work may take you into stress and vibrations analysis . . . mechanical analysis . . . design, materials, and processes. Designing combustors, compressors, turbines and the like is man-size work for the engineer on the move.**

**Experienced with high-speed rotating machinery or any of the above? Then learn more about this small young group today. Remember, your professional development sets the pace for our success.**

**Write us in complete confidence.**

P-6212
Aviation Week
Class. Adv. Div., P. O. Box 12, N. Y. 36, N. Y.

**MECHANICAL ENGINEERS**

*prime requisites for a career in nuclear flight propulsion*

- ***Good Fundamental Training***
- ***A Flexible Point of View***

Developing an atom-powered engine requires the combined efforts of professional men from many technical areas.

If you have from 1 to 5 years' experience General Electric will provide the specialized knowledge necessary to apply your skills to the nuclear propulsion project here—already in the product stage.

We start you right in with assignments in project areas like these:

**THERMODYNAMICS & AIRCYCLE ANALYSIS**
**TURBO-JET APPLICATIONS**
**FLUID FLOW**
**REACTOR DESIGN & STRUCTURES**
**HEAT TRANSFER**
**REMOTE HANDLING**
**POWER PLANT COMPONENTS**
**SHIELD DESIGN**
**STRESS & WEIGHT ANALYSIS**
**AIRFRAME & STRUCTURES**

In-plant seminars and expert supervision will thoroughly ground you in the basics of nucleonics technology. You'll have access to such complex facilities as an engine test cell, digital and analog computers, and you can take graduate courses on a Full Tuition Refund Plan.

COMPREHENSIVE BENEFITS
FREQUENT MERIT REVIEWS
RELOCATION EXPENSES PAID

**PUBLICATION OF TECHNICAL PAPERS IS ENCOURAGED**

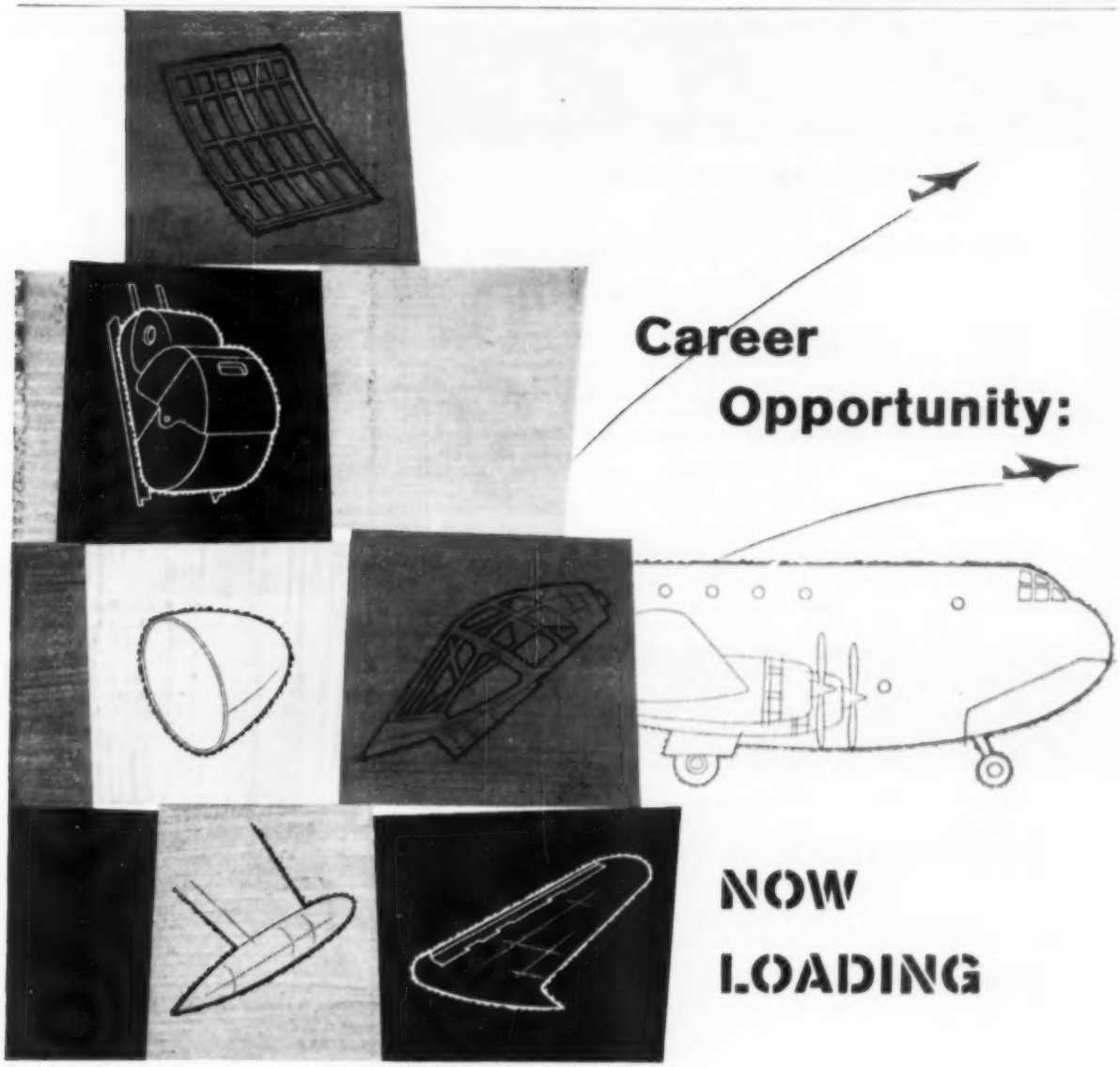
**Choice of two locations:**
**Cincinnati, Ohio &**
**Idaho Falls, Idaho**

*Write in confidence, stating salary requirements, to location you prefer:*

**Mr. J. R. Rosselot**
**P. O. Box 132**
**Cincinnati, Ohio**

**Mr. L. A. Munther**
**P. O. Box 535**
**Idaho Falls, Idaho**

**GENERAL ELECTRIC**




HERE YOU SEE some of the major components now being supplied by Goodyear to major aircraft manufacturers. Goodyear engineers had a hand in virtually all of them.

Helping to outfit these winged powerhouses is just one of the exciting activities at Goodyear Aircraft these days. Important parts are being built for guided missiles — there are stimulating developments in electronics, radar structures, plastics, metals and countless other projects.

All this spells opportunity unlimited for engineers. Our continued growth and diversification have required expansion of our engineering staffs in all specialties at both Akron, Ohio, and Litchfield Park, Arizona. Available for your use are the most modern engineering and research laboratories, including a large computer laboratory.

If you have an eye to the future — and it's focused on the sky — a rewarding career can be yours at Goodyear Aircraft. Salaries and benefits are liberal, of course. And if you wish to continue your academic studies, company-paid tuition courses leading to advanced degrees are available at nearby colleges.

For further information on your career opportunities at Goodyear Aircraft, write: Mr. C. G. Jones, Personnel Dept., Goodyear Aircraft Corporation, Akron 15, Ohio.

*They're doing big things at*

**GOODYEAR AIRCRAFT**

**ENGINEERS & SCIENTISTS**

*If Your Goal Is*

*Professional Maturity & Technical Excellence–*

*Consider* **Magnavox**

When uncompromising excellence is required in the design and development of radar, communications and navigation systems, computers, and electro-mechanical devices, you'll hear the name of Magnavox . . . because Magnavox has built its reputation on quality, integrity, originality, for forty-six years. Engineers who share this devotion are now offered important opportunities at all levels in the following areas:

**COMMUNICATIONS & NAVIGATION**—airborne, shipboard and ground equipments.

**RADAR** — airborne equipments and fire-control systems.

**COMPUTERS** — analog and digital techniques.

**ELECTRO-MECHANICS**—synchros, speakers, and components.

Choice of three locations: home office and headquarters R & D Laboratory in Fort Wayne, Indiana, described by Look Magazine as the happiest city in the United States; our brand-new electronics laboratory in Urbana, home of the University of Illinois; or our laboratory in Los Angeles, California.

*Please send resume to:*
Mr. Robert B. Wright, Technical Personnel Director

THE MAGNAVOX CO.
FORT WAYNE 4, INDIANA

## EXECUTIVE OPPORTUNITY WITH CESSNA AS A REGIONAL SERVICE MANAGER

- Must be able to meet and sell executive management and shop personnel on factory service planning and execution.
- Aeronautical, Mechanical or A & E background required.
- Component pilot essential

Cessna

If you meet these requirements and are interested in unlimited opportunity with the World's Leading Designers and Manufacturers of Business Aircraft, send your resume and recent photograph to the

**Professional Placement Supervisor, Dept. AW,**
**CESSNA AIRCRAFT COMPANY**
**5800 East Pawnee Road, Wichita, Kansas**
(NO PHONE CALLS, PLEASE)

## CUSTOMER FLIGHT TEST *Engineers*

**FOR GENERAL ELECTRIC'S JET ENGINE DEPARTMENT**

Several openings exist in this area, for qualified men, to work with our customers — leading aircraft and missile manufacturers in the commercial and military field.

**YOUR JOB WILL BE TO —**

- Furnish support for flight test programs of the customer.
- Interpret and evaluate customer test data as applied to engine performance.
- Recommend engine design changes.

**YOU MUST HAVE —**

A BS degree with two to five years' experience and sound knowledge of aircraft or missile flight test or performance. Customer contact experience is necessary, you must be able to make important decisions, you must know how to communicate successfully.

***FURTHER IT WILL HELP IF YOU HAVE***

EVALUATION OR DESIGN EXPERIENCE, KNOWLEDGE OF ENGINE PERFORMANCE AND GOOD UNDERSTANDING OF MARKETING PRINCIPLES.

Openings are in our Evendale Plant in suburban Cincinnati, Ohio. You will work in a professional atmosphere . . . all your talents are recognized . . . in-plant opportunities are exceptional . . . company benefits are liberal.

NOTE TO Engineers

Many highly responsible positions are also open in other fields for men experienced in mechanical and aeronautical design of gas turbine components.

Write, in confidence to:

Mr. J. A. McGovern
Professional Placement, Jet Engine Dept.
Building 501 — Room A-108 POplar 1-1100

GENERAL ELECTRIC
CINCINNATI 15, OHIO

**ENGINEERS**

If you have been looking for an Employment Agency that is skilled in the **STATE OF THE ART** of Technical Recruitment and **RELIABILITY OF INFORMATION** concerning positions, why not communicate with us at once! ALL POSITIONS FEE PAID.

FIDELITY PERSONNEL SERVICE
1218 Chestnut St. Phila. 7, Pa.
*Specialists in Aviation, Electronics and Nucleonics*

***When Answering* BOX NUMBERS . . .**

**to expedite the handling of your correspondence and avoid confusion, please do not address a single reply to more than one individual box number. Be sure to address separate replies for each advertisement.**

BURROUGHS ALWAYS NEEDS *Good* ENGINEERS

# MAN plus a Computer equals a GIANT!

Teamwork is an essential ingredient of all successful activity, be it between man and man, man and beast or man and the machinery which his mind creates. The man-computer team is the latest of modern industry's unbeatable combinations. Separately, each is restricted in scope of activity and accomplishment. Together, as a working team, they add up to nothing less than a giant

Keeping the varied abilities of himself and the computer in balance, is scientific man's control over this potent new force that is rapidly shaping much of today's industrial philosophy. By harnessing the computer's fantastic speed and accuracy, he is solving heretofore impossible problems and opening roads to virgin fields of advanced thought.

Engineering and improving upon these new electronic devices is the special job of our creative teams at the Research Center. You, too, can be a part of this program of planned progress that has made Burroughs the foremost name in computation.

Our present needs are for people experienced in Electronic Digital Computers, Guided Missiles, Radar, Fire Control Systems and allied areas of electronics, with specific emphasis on men who by education or experience can qualify for the openings listed herein.

- ELECTRONIC ENGINEERS
- MECHANICAL ENGINEERS
- PHYSICISTS
- SYSTEMS ANALYSTS
- OPERATIONS ANALYSTS
- LOGICAL DESIGNERS
- MATHEMATICIANS

*Write or Telephone*
**M. E. JENKINS**
*Placement Manager*
**PAOLI 4700**
**For Interview at Your Convenience**

**BURROUGHS CORPORATION**
*Research Center*
**PAOLI, PA.**
*On Philadelphia's Main Line, Near Historic Valley Forge*

# COMMERCIAL SALES ENGINEER

Link Aviation, Inc., the world's pioneer and leader in the field of flight simulation, has an immediate opening for a commercial sales engineer.

The applicant for this position should be between 25 and 40 years old, and have pilot or co-pilot experience with a commercial airline. Degree in electrical or aeronautical engineering is desirable, and some industrial selling experience is required since this job involves personal contact with many of the world's leading airlines.

To the qualified applicant, Link extends an outstanding opportunity for personal advancement in a growing organization. In addition to a sound salary program, Link also offers an attractive fringe benefit package, including profit-sharing, group insurance plans, and a generous vacation and holiday schedule.

Located just outside the city of Binghamton, in picturesque upstate New York, Link is only 180 miles from New York City.

If you would like to arrange a personal interview, please write or send your resume to

**KENNETH T. VIALL, *Manager, Employment***

LINK AVIATION, INC.
A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION
BINGHAMTON, NEW YORK

GPE

## Export Representatives in the Aircraft Sales Management Field

If you are a capable pilot, speak Spanish fluently, have sales ability, and are 35 years of age or under, you may have an outstanding future in aviation with a South American assignment from the nation's leading business aircraft manufacturer. You must be free to travel or relocate. The salary range is $5,000 to $7,500. Please send a brief resume with recent photo to Roy A. Kunz, Executive Employment Division, Beech Aircraft Corporation, Wichita 1, Kansas.


## *USE NATIONAL CLASSIFIED ADVERTISING*

for bringing business needs or opportunities to the attention of men associated in administrative, executive, management, sales and responsible technical, engineering and operating capacities with the industries served by McGraw-Hill publications. For advertising rates or other information write:

**Classified Advertising Division—McGraw-Hill Publishing Co., Inc.**
330 West 42nd Street, New York 36, New York


## Top Professional positions for qualified . . .

## NUCLEAR ENGINEERS

- **PRELIMINARY DESIGN**

  Must be experienced in power plant field with nuclear energy as power source. You will be a member of a small advanced planning team having responsibilities in areas of nuclear application to propulsion systems. Should know nuclear technology, experience in propulsion desirable but not necessary. Salary from $10,000 to $12,000 per year.

- **PROPULSION LIAISON**

  Must have technical knowledge to recognize problems and able to take immediate corrective action. You will serve as representative of project manager, responsible for testing at remote testing site. Five years in testing service experience. Half of time spent in travel between development and testing site. Salary from $10,000 to $12,000 per year.

These are two highly responsible management positions, that must be filled immediately. Excellent opportunities for engineers with sufficient background to get into the propulsion field where it counts.

Our midwest location offers big city conveniences, modern schools and shopping, with pleasant suburban living.

Our company is known for stability and liberal benefits. We pay relocation expenses, of course.

*We will acknowledge your resume immediately. Write Room A-117*

**P-6110, AVIATION WEEK**
**520 N. Michigan Ave., Chicago 11, Ill.**

# NEED

?

# AERONAUTICAL ENGINEERS

?

They—and their assistants—are the readers of this magazine. You can hire them by placing a "position vacant" advertisement where they are sure to see it—in our Employment Opportunities section.

# AVIATION WEEK

*Classified Advertising Division*

## BSME's and BSAE's

**For Leading Gas Turbine Development Organization**

**Ours is a pioneer company in this field. Our engineers exchange ideas in small groups. They work on the most advanced propulsion systems now being developed.**

**TURBINE ENGINEERS**

- with mechanical and aerodynamic design experience.
- to carry out the aerodynamic studies required for the design and development of specific turbine units or parts.
- to undertake the analysis and solution of novel mechanical design problems encountered in high speed, high temperature usage.

**COMPRESSOR ENGINEERS**

- experienced in aircraft gas turbines.
- responsible for the mechanical design of assigned components within the group working on the compressor.
- to establish, design and develop programs for assigned components.

**Our large modern plant is in a big city, midwestern location. Benefits are substantial. Direct your resume to Room A-98.**

P-5960, Aviation Week
520 N. Michigan Ave., Chicago 11, Ill.

## RESEARCH
### in Fluid Flow

WE NEED A MAN WITH A STRONG THEORETICAL BACKGROUND CAPABLE OF APPLYING OPTICAL AND ELECTRONIC INSTRUMENTATION TO RESEARCH IN FLUID FLOW AND RELATED STUDIES. TECHNICAL AND TECHNICIAN ASSISTANCE WILL BE PROVIDED. SUBMIT RESUME TO:

**Goodyear Atomic Corporation**
**Employment Dept. K-58**
**P. O. Box 628**
**Portsmouth, Ohio**

## *To EMPLOYERS Who Advertise for MEN:*

Frequently, when there are many applicants for a position, only the most promising letters are acknowledged. The other applicants never know whether their letters reached a prospective employer or not. These men often become discouraged, will not respond to future advertisements and even question their bona fide character.

*Every Advertisement Printed Is Duly Authorized.*

You can help keep our readers interested and get better returns to your advertising in this section if you acknowledge each reply—in plain envelopes, if you wish.

*Classified Advertising Division*
**McGRAW-HILL PUBLISHING CO., INC.**
*"Put Yourself in his place."*

## *DESIGN ENGINEER*

## PATTERN FOR SUCCESS IN RADAR CIRCUITRY

- ***ORIGINATE***
- ***CARRY-THROUGH***
- ***DIRECT***

***Have you the three-way capability that leads to high professional success in electronic design? Can you...***

***ORIGINATE*** designs in radar circuitry to exploit the full capacities of extremely advanced, intricately complex Airborne Search Radar and ECM Systems, concepts now under development at the Light Military Department of General Electric.

***CARRY-THROUGH*** the design projects all the way from basic research to actual production...run your project the way you think it should be run.

***DIRECT*** the activities of several engineers. You can count on 3-to-1 technical assistance ratio, as well as the most complete and up-to-date facilities.

Three to five years experience preferred, including a working knowledge of the latest techniques and devices, and an understanding of transmitters, receivers, MTI Systems, delay channels and filters. Related experience considered.

***If this three-way approach is your approach, mail the coupon today for further information.***

Mr. Richard C. Kimm 864-A
Light Military Electronic Equipment Dept.
General Electric Company
French Road, Utica, N. Y.

Please send me further details on opportunities at Light Military Department.

NAME_____

DEGREE_____

ADDRESS_____

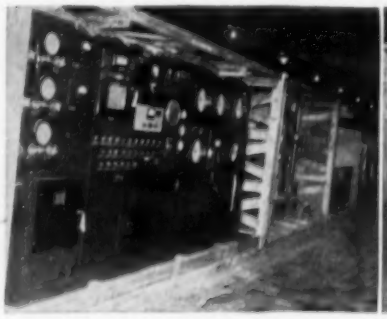
LMEE
LIGHT MILITARY ELECTRONIC EQUIPMENT DEPARTMENT
GENERAL ELECTRIC
FRENCH ROAD, UTICA, NEW YORK

# AUCTION

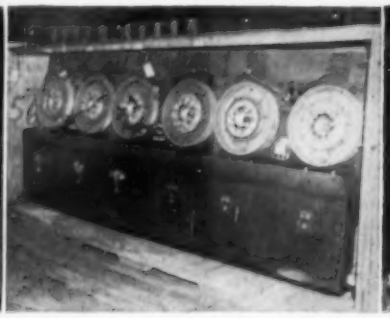
**$3,000,000.00—AERONAUTICAL PARTS**
**C-117—C-47—C-54—PARTS COMMON**

**$1,000,000.00—ASSORTED NON-FRICTION BEARINGS**

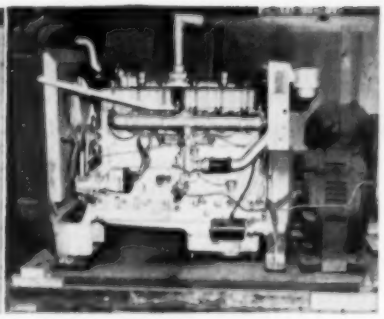
**$1,000,000.00—VEHICLE AND AVIATION SHOP EQUIPMENT, MACHINERY, LATHES, MULTIPLE DRILL PRESSES, INCLUDING MODERN RECIPROCATING AND JET AERONAUTICAL TEST EQUIPMENT**



Stand Assy, water-alcohol in three sections, fuel, air supply and console



Test Stand, check run-in fuel pump (gas and oil)



Generator Set, Mfg. by Waukesha, gasoline engine driven, Model 145-GK

**SALE TO BE CONDUCTED IN BLDG #S-45 THROUGH GATE #4 OFF 3RD STREET**

## NORTON AIR FORCE BASE
## SAN BERNARDINO, CALIFORNIA

8:30 A.M. 25 OCT. THROUGH 11 A.M. 26 OCT.
AERONAUTICAL PARTS
11:45 A.M. 26 OCT. UNTIL SOLD

**BEARINGS, MACHINERY AND TEST EQUIPMENT**

THE 997 ITEMS OF PROPERTY MAY BE INSPECTED AT WAREHOUSE NO. 948, NORTON AIR FORCE BASE 8 A.M. TO 3 P.M. DAILY EXCEPT SATURDAY AND SUNDAY UNTIL 25 OCT. 1957. A COMPLETE ITEMIZED CATALOG WILL BE AVAILABLE AT SALE SITE FOR CONVENIENCE WHILE INSPECTING PROPERTY.

**ADVANCE COPIES OF CATALOG MAY BE OBTAINED BY CONTACTING CHIEF, MARKETING BRANCH, NORTON AFB, CALIF. PH: TU 94411—EXT. 6142.**

(SEARCHLIGHT Continued on pages 170-172)

# ENGINEERS and SCIENTISTS...

## The story is in this book...

**JUST RELEASED**

- You can get the facts now why MAC is a good choice to further your aviation career...
- Fill in the coupon below and request your copy now
- Supply is limited

**CURRENTLY IN PRODUCTION**

*Details on MAC's Operations for Fiscal 1957 Showing*

- **27,107 employees***
- **3,284,607 square feet floor space***
- **$728,192,668 backlog***
- **$335,287,764 sales in fiscal 1957**
- **completely integrated facilities in St. Louis (with pictures of our ultra-modern engineering campus).**

**Naturally, our engineering application form will be enclosed along with a copy of our pamphlet "St. Louis, A Good Place To Live." This pamphlet is packed with valuable data on living conditions in the St. Louis area.**

**As of 30 June 1957*

To: Raymond F. Kaletta, Tech. Placement Supvr.
Box 516 c/o MAC
St. Louis 3, Missouri

Please send me a copy of the McDonnell Aircraft Annual Report for Fiscal 1957

Name _____

Address _____

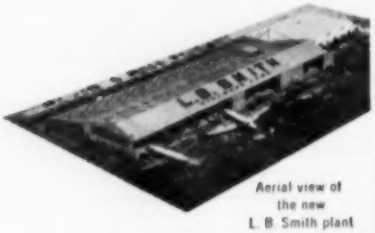
College attended _____

Type engineering degree and year received _____

Type assignment in which interested _____

## vastly expanded new facilities

L. B. Smith's new 80,000 square foot hangar building houses the most advanced business and commercial aircraft sales, service, conversion and manufacturing facilities available in this hemisphere. Personalized customer service for the business pilot and plane owner provide for your every need . . . including complete flight planning data, lounge, coffee shop, office facilities with secretarial help, hotel reservations and car rentals. We invite your inspection of these new facilities.



Aerial view of the new L. B. Smith plant

**L. B. Smith**
**AIRCRAFT CORPORATION**
International Airport • Miami, Florida

---

**Minnesota Airmotive, Inc.**
NORTH CENTRAL STATES BEST EQUIPPED FACILITY SERVING
*Minnesota Airmotive*
DISTRIBUTOR FOR:

Aero Commander
Lycoming Engines
Collins Radio
Bendix Aviation
ARC Products
Champion Spark Plugs
Dare Aviation Radio
Hartzell Propellers
Kollsman
Lear Aviation Equipment
Flitetronics
Narco Products (Sub-Distributor)
Pioneer Instruments
RCA (Radio and Radar)
Sperry Aviation
Wakmann Watches
B. F. Goodrich Aeronautical Products
Pesco Products
Goodyear Aviation Products (Dealer)
Texas Company
Aircraft Instrument Manufacturers
McMillan Radomes

*The Flying Public*

- MAINTENANCE
- INSPECTION
- CONVERSION
- ENGINEERING

Distributor for Aero Commander Aircraft, North Dakota, South Dakota, Minnesota and Iowa

Manufacturers of the Super Lodestar.

**Minnesota Airmotive, Inc.**
**Wold Chamberlain Field • Minneapolis**

---

*Deal directly with owner*
**For Sale—Immediate Delivery**
*26 passenger ex-Eastern Wright G202A*
**DC-3**
Full airline equipment
**$100,000.00**
TRADE-AYER CO.
Linden Airport, Linden, N. J.
Hunter 6-7690

---

**FOR IMMEDIATE SALE OR LEASE**
**B25J**

Presently in use as flying laboratory R-2600-29. Engines 65-399 hours, 1688 total time on airframe. Can be used as experimental plane or reconverted for executive use. Full instrument panel, S200 Janitrol heater, excellent radio, full Ryan exhaust collector ring.

*FOR COMPLETE SPECIFICATIONS CONTACT*
R. L. CAINE
**GENERAL ELECTRIC COMPANY**
FLIGHT TEST CENTER
130 SARATOGA ROAD
SCHENECTADY, NEW YORK
PHONE: FRANKLIN 4-2211, EXT. 2023 OR 2435

---

**FOR SALE**
All-Metal, Five-Place, High Performance
**TRECKER GULL AMPHIBIAN L-1**

Powered by two Lycoming 270 hp. engines with Hartzell full-feathering constant-speed props.

Dual controls and brakes; lights; heater; retractable tailwheel and rudder; flasher beacon; engine and windshield covers.

Complete instrumentation. Two DARE 22 channel VHF omni transceivers. ADF, marker beacon, and glide slope.

Exterior Alaska white with red trim. Interior in genuine red and tan leather.

Aircraft was new in February, 1957. Total time only 170 hours.

For immediate sale at exceptionally attractive price.

**HOBART A. H. COOK ASSOCIATED**
Copiague Road
North Lindenhurst, L. I., N. Y.
*(Zahn's Airport)*

---

THE
**SKYMOTIVE**
STORY
*Complete*
PASSENGER and CREW
ACCOMODATIONS
*kymotive*
**O'HARE FIELD CHICAGO**

---

**Now we're in Chicago too!**

The clamor of friends who like our engine O/H services has forced us to open a branch office at Chicago International Airport. The number to call in Chicago for engines or service is GLadstone 1-0138, and its FAculty 1-3414 in L. A.

**STEWARD-DAVIS, INC.**

# PAC

**OVERHAUL • SALE • EXCHANGE • LEASE**
**All Models Pratt & Whitney Engines**

**R985 R1340 R1830**
**R2000 R2800**

**Introducing modernized R2800 engines delivering horsepowers comparable to the R2800-CB. Available immediately or upon scheduled delivery.**

**Write, Phone or Cable today.**

**Sales Manager, Engine Division**
**PACIFIC AIRMOTIVE CORPORATION**
**2940 North Hollywood Way**
**Burbank, California**
**Victoria 9-3481 THornwall 2-5171**

---

**FOR SALE**

## C-46F's

**Original "F" Models**

Flying Tiger Fleet of These Aircraft now Offered for Sale—Maintained to Airline Standards and Available in either Passenger or Cargo Versions—With or Without T-Category—Immediate Delivery.

**THE FLYING TIGER LINE INC.**
**Lockheed Air Terminal**
**Burbank, California**
**Attn: Fred Benninger**
**Executive Vice President**
**Tel: Stanley 7-3411 Cable: Flytiger**

---

# CONVAIR 240

**BUSINESS**
**AIRCRAFT**
**CONVERSION**

Leading business aircraft conversion center is now in position to give firm quotations for the conversion of American Airline Convair 240's to deluxe business aircraft. Write or wire for proposal.

## L. B. SMITH

**AIRCRAFT CORPORATION**
CONVERSION DIVISION
INTERNATIONAL AIRPORT
MIAMI, FLORIDA

---

## SALE OR LEASE

**SUPER 18**

1957. Low time, as new aircraft. Excellent value. Well equipped.

**MODEL D-18S**

1946. Airwork overhauled low time engines. Past history of excellent maintenance.

**TWIN BONANZAS**

1954. 2 Twin Bonanzas Model B-50. Autopilot. Exceptional radio. Real values.

**APACHE**

1955. Exceptionally clean. 1 owner aircraft. Full complement radio. Dual generators.

*For details, call or write:*

**ATLANTIC AVIATION CORP.**
**Teterboro Airport**
**Teterboro, New Jersey**
***ATlas 8-1740***

---

**WORLD'S FOREMOST**

## LODESTAR

**SERVICE CENTER**

| | |
|---|---|
| Inspection | Radar |
| Maintenance | Interiors |
| Instrumentation | Engine Change |
| Modification | Exteriors |
| Overhaul | Radio |

**PacAero Engineering Corp.**
**(Formerly Lear Aircraft Engineering Division)**
**Santa Monica Airport, Santa Monica, California**
***Builders of the Incomparable Learstars***

---

# ACES

**OVERHAUL • EXCHANGE • LEASE**
**ALL P&W ENGINE MODEL'S**

**R985 - 1340 - 1830 - 2000**
**R2800 M1 & M2**
**R2800 C Series**

*IMMEDIATE DELIVERY*

The original M1 & M2 as engineered by ACES copied by many but never duplicated by any. CAA approved repair station—powerplant class 2

***Write, Phone or Cable Today***
***Sales Manager***

**AIR CARRIER ENGINE SERVICE, INC.**
**P. O. Box 236, Miami 48, Fla.**
**Tuxedo 7-2666**

---

## Immediate Delivery

**We stock, overhaul, and install**

| PRATT & WHITNEY | WRIGHT |
|---|---|
| **R1830** | **R1820** |
| **–75, –92, –94** | **–202, –56, –72** |

**R985 R1340 R2000**

**and our most popular DC3 engine**
**R1830 - SUPER - 92**

## ENGINE WORKS

**INC.**

**Lambert Field Inc. St. Louis, Mo.**

---

# 1 C-46F
# 1 C-46A

**(airfreighters)**

Sale or lease. Low airframe time, very clean. C-46F fully equipped for scheduled operations. *Write or wire.*

**COLONIAL AIRCRAFT CORPORATION**
**P. O. Box 693**
**Miami Springs, Florida**

---

**TWO UNUSUAL OPPORTUNITIES—OWNER SEEKING REASONABLE OFFERS**

**Douglas DC-3 and Beechcraft D-18S.** Both with luxury executive-type interiors complete with galley, lavatory, tables, large storage space and scores of other "extras". Complete dual instrumentation, full radio equipment and auto pilot. DC-3 seats 12. D-18S seats 4. Each airplane is in perfect mechanical condition. For complete details, contact:

**William C. Weld Associates, 551 Fifth Avenue, New York 17, New York. MU 7-2050.**

---

## NAVCO

**Inc.**

**Lambert Field**
**St. Louis, Mo.**
**PErshing 1-1710**

**has in stock**

**A.R.C. Bendix Collins**
**Sperry Wilcox**
**Executive Aircraft Radio**

---

## SPARKPLUGS WANTED

**Surplus or used aircraft sparkplugs wanted. Highest prices paid for R.D. 19R, 4865Z, 5/2, 5/3, 5/4, 5/5, 23R, 27-R, 23, 21262, 31262; R.P. 43S; LR 44, 45; L.S. 4S; A.C. 18I, 28I; R.S. 19-2R, 14-1R; R.C. 9R; R2-14-R; R-214; R.N. 5/3; 59052, 61382 63S*, 64S.**

**RADIO & ELECTRONICS SURPLUS**
**14000 Brush St. Detroit 3, Mich.**

---

**SERVING THE INDUSTRY AS SUPPLIERS OF DOUGLAS PARTS AND COMPONENTS**

## FARRAR AVIATION

**WE SOLICIT OPEN ACCOUNTS FROM WELL RATED FIRMS**

**One of the world's largest inventories of**
**DOUGLAS**
**DC-3 & DC-4 PARTS**

**325 WEST MAIN STREET P. O. BOX 113 ONTARIO, CALIF. YUkon 6-6746 CABLE ADDRESS "FARRAIR"**
**FARRAR AVIATION WUR**
**State Dept. Export Reg. No. 6138**

- COLLINS
- BENDIX
- SPERRY
- LEAR
- ARC

**Page AIRWAYS INC.**
ROCHESTER AIRPORT
PHONE GENESEE 8-7101
ROCHESTER 11, N.Y.

**RADAR**
AUTOMATIC PILOTS
NAVIGATION AND
COMMUNICATION SYSTEMS



*For Immediate Sale*

**Cessna 310—1955 TT 1250**
Maximum instrumentation auto pilot—deicer system. Spare engine kit—excellent condition.

**Beechcraft D18S—1952 TT 2200**
Dual instrumentation—deicer system—excellent radios. Crews available for both A/C.

The BLACK-CLAWSON COMPANY
250 Park Avenue, New York 17, New York
YUkon 6-7850



Deal Directly with Owner

WRIGHT 1820-56
A/F 3557 hrs.
Engines 74 and 327

Very nice executive
LOCKHEED LODESTAR
N300E
Serial 2312

Complete radio, good tanks. Attractive blue and light gray exterior. Beautiful tere, highest quality Horton and Horton executive interior. Exceptional value at

**$105,000.00**
"Immediate delivery"

TRADE-AYER COMPANY
Linden Airport Linden, N. J.
HUnter 6-7690

*IMMEDIATE DELIVERY*

**C-47 B**

R 1830-92 eng. Total time 1415 hrs. Manuf. 1945. Ser. No. 32887. Completely overhauled zero time. New CAA Cert. of Airworthiness. Can be inspected in New York City area.

FS-6005, Aviation Week,
Class. Adv. Div., P. O. Box 12, N. Y. 36, N. Y.



*WANTED*

Sales Representative—For Aircraft Parts Co. AN & MS Hardware and Fittings; also complete line of other classes of Aircraft Parts.
Must have experience and contacts. Submit complete Sales background by phone or letter.

COLLINS ENGINEERING CORPORATION
9050 Washington Blvd., Culver City, California
Attn: Joe Collins



**SUPER CUSTOM APACHES**
*FOR SALE OR LEASE*

1955 TT 585; 1956 TT 330; 1957 TT 78. 3 very fine planes.

GEORGE H. BAILEY COMPANY, INC.
3508 Quimby Arcade - Ft. Wayne, Ind.



IN ALL INTERESTS
OF AVIATION

If You're Important,
you either read

AVIATION WEEK

or you advertise in
it, or both.


# EMPLOYMENT OPPORTUNITIES

*REPLIES (Box No.): Address to office nearest you c/o This publication Classified Adv. Div.*
*NEW YORK: P. O. Box 12 (36)*
*CHICAGO: 520 N. Michigan Ave. (11)*
*SAN FRANCISCO: 68 Post St. (4)*

### *POSITIONS WANTED*

**Pilot, commercial single or multi engine.** Land/Sea 3300 accident free hours. Naval officer. 39 years of age with instructor/administrative and operational experience. Desire aviation executive or sales flying position. PW-6080, Aviation Week.

**Insurance Executive—Law Graduate 37—** Family—All phases auto and aviation insurance. Heavy pilot experience. Desires insurance—aviation connection. PW-6114, Aviation Week.

**Co-pilot-Mechanic position wanted. Ten** years A&E. Commercial pilot, instrument. Curtis Cleland, 1211 Division, Napa, Calif.

**Naval Aviator. Age 24. 1000 Hrs.. SMEL &** Inst. rating. Desire position as Executive Charter, or Production Test Pilot. PW-6251, Aviation Week.

### *BUSINESS OPPORTUNITY*

**Desire active partnership in (or on profit** sharing basis) an aircraft radio service. Interested in organizing similar service for distributor. Presently employed as technical representative with commercial and military aircraft experience. BO-6241, Aviation Week.

## FOR RATES OR INFORMATION

### About Classified Advertising

*Contact*
*The McGraw-Hill*
*Office Nearest You.*

ATLANTA, 3
1301 Rhodes-Haverty Bldg.
JAckson 3-6951
M. MILLER

BOSTON, 16
350 Park Square
HUbbard 2-7160
J. WARTH

CHICAGO, 11
520 No. Michigan Ave.
MOhawk 4-5800
W. HIGGENS
J. BRENNAN

CINCINNATI, 37
2005 Seymour Ave.
ELmhurst 1-4150

CLEVELAND, 15
1510 Hanna Bldg.
SUperior 1-7000
W. SULLIVAN

DALLAS, 2
1712 Commerce St.
Vaughn Bldg.
Riverside 7-5117
G. MILLER

DETROIT, 26
856 Penobscot Bldg.
WOodward 2-1793
W. STONE

LOS ANGELES, 17
1125 W. 6 St.
MAdison 6-9351
G. FRUHLING
D. McMILLAN

NEW YORK, 36
500 Fifth Ave.
OXford 3-5959
S. HENRY
D. COSTER
R. LAWLESS

PHILADELPHIA, 3
17th & Sansom St.
Rittenhouse 6-0670
H. BOZARTH
R. EDSALL

ST. LOUIS, 8
3615 Olive St.
JEfferson 5-4867
F. HOLLAND

SAN FRANCISCO, 4
68 Post St.
DOuglas 2-4600
W. WOOLSTON

# ADVERTISERS IN THIS ISSUE

AVIATION WEEK, OCTOBER 7, 1957


**AC THE ELECTRONICS DIV., GENERAL MOTORS CORP.** ..... 135
Agency—E. H. Brown Adv.
**A.C. SPARK PLUG THE ELECTRONIC DIV. GENERAL MOTORS CORP.** ..... 102
Agency—D. P. Brother & Co.
**AEROQUIP CORPORATION** ..... 74-75
Agency—The Fred M. Randall Company
**AIRTRON INC.** ..... 150
Agency— Curtis Adv. Inc.
**AIRWORK CORPORATION** ..... 131
Agency—Gene Wyble Advertising
**ALUMINUM CO. OF AMERICA** ..... 116
Agency—Fuller & Smith & Ross, Inc.
**ALUMINUM TAPER MILLING CO., INC.** ..... 128
**AMPEX CORPORATION INSTRUMENTATION DIVISION** ..... 133
Agency—Roland Associates
**AMPHENOL ELECTRONICS CORPORATION** ..... 100
Agency—Burton Browne Adv.
**AMP, INCORPORATED** ..... 148
Agency—M. Russell Berger, Inc.
**ATLAS PRECISION PROD. CO., DIV. PRUDENTIAL INDUSTRIES** ..... 83
Agency—A. E. Aldridge Associates
**AVCO MANUFACTURING CORPORATION, LYCOMING DIVISION** ..... 110
Agency—Benton & Bowles, Inc.
**AVRO AIRCRAFT LIMITED** ..... 36
Agency—Cockfield, Brown & Co., Ltd.

**B & H INSTRUMENT CO., INC.** ..... 8
Agency—The Kotula Company
**BARBER-COLMAN COMPANY** ..... 11
Agency—Howard H. Monk & Associates, Inc.
**BARNES ENGINEERING COMPANY** ..... 79
Agency—Fred Wittner Adv.
**BENDIX PRODUCTS DIV., BENDIX AVIATION CORP.** ..... 3rd Cover
Agency—MacManus, John & Adams, Inc.
**BOEING AIRPLANE COMPANY** ..... 120
Agency—Calkins & Holden, Inc.
**BRILES MFG. CO.** ..... 7
Agency—O. K. Fagan Adv.
**BURNDY CORPORATION** ..... 9
Agency—The Wexton Co. Inc.

**CALIFORNIA TECHNICAL INDUSTRIES** ..... 140
**CAMERON IRON WORKS, INC., SPECIAL PRODS. DEPT.** ..... 94
Agency—Boone & Cummings, Adv.
**CENTURY ELECTRONICS & INSTRUMENTS, INC.** 103
Agency—Gibbons Adv. Inc.
**CHANDLER EVANS** ..... 6
Agency—G. F. Sweet & Company, Inc.
**CHANCE VOUGHT AIRCRAFT, INC.** ..... 60-61
Agency—Tracy Locke Adv. Co., Inc.
**COLVIN LABORATORIES** ..... 140
Agency—J. G. Proctor Co.
**CONVAIR—DIVISION OF GENERAL DYNAMICS CORPORATION** ..... 35
Agency—Buchanan & Company, Inc.
**COUCH ORDNANCE INC.** ..... 107
Agency—Kenneth A. Young Assoc.

**DALLAS AIRMOTIVE, INC.** ..... 155
Agency—Jack Kemp & Associates
**DAYSTROM INSTRUMENT, DIVISION DAYSTROM INC.** ..... 69
Agency—Morse Adv.
**DETROIT CONTROLS, AMERICAN STANDARD DIV.** ..... 57
Agency—K. Gunnar Myrbeck & Co.
**DOUGLAS AIRCRAFT COMPANY** ..... 114
Agency—J. Walter Thompson Company
**DOW CORNING CORPORATION** ..... 106
Agency—Church & Guisewite, Inc.

**EASTERN INDUSTRIES INC.** ..... 152
Agency—Remsen Adv. Agency, Inc.
**EDISON, IND., THOMAS A.** ..... 16
Agency—Gaynor, Colman, Prentis & Varley, Inc.
**ELECTRIC STORAGE BATTERY COMPANY EXIDE INDUSTRIAL DIV.** ..... 68
Agency—Gray & Rogers Adv.
**ELECTRO DATA DIVISION—BURROUGHS CORPORATION** ..... 98
Agency—Carson-Roberts, Inc.

**FAIRCHILD ENGINE & AIRPLANE CORPORATION** ..... 24
Agency—Gaynor, Colman, Prentis & Varley, Inc.
**FLIGHT REFUELING, INC.** ..... 128
Agency—Davis, Parsons & Strohmeier, Inc.
**FORMSPRAUGE** ..... 101
**FULTON-SYLPHON DIV. ROBERTSHAW-FULTON CONTROLS CO.** ..... 17
Agency—Arndt-Preston-Chapin-Lamb & Keen, Inc.

**GARRETT CORPORATION—AIRESEARCH MFG. DIVISION** ..... 54-55
Agency—J. Walter Thompson Company
**GENERAL ELECTRIC COMPANY, ELECTRONIC COMPONENTS DIV.** ..... 96
Agency—Maxon, Inc., Adv.
**GENERAL MILLS, INC.** ..... 145
Agency—Knox Reeves Advertising, Inc.
**GIANNINI & COMPANY INC., G. M.** ..... 99-115-122
Agency—Western Advertising Agency, Inc.

**GOODRICH COMPANY, THE B. F. AVIATION PRODUCTS CO.** ..... 20
Agency—Batten, Barton, Durstine & Osborn, Inc.
**GRUMMAN AIRCRAFT ENGINEERING CORPORATION** ..... 48-49
Agency—Fuller & Smith & Ross, Inc.

**HALLAMORE ELECTRONICS COMPANY—DIV. SIEGLER CORPORATION** ..... 76
Agency—Getz & Sandberg, Inc.
**HARDMAN TOOL & ENGINEERING CO.** ..... 141
Agency—The Essig Co.
**HANNISCHFEGER CORPORATION, WELDING DIVISION** ..... 134
Agency—Hoffman & York, Inc.
**HARTWELL AVIATION SUPPLY COMPANY** ..... 77
Agency—The McCarty Company
**HOUGH CO., FRANK G.** ..... 83
Agency—Edwin R. Abramson Adv. Inc.
**HUGHES AIRCRAFT COMPANY, RESEARCH & DEVELOPMENT LAB.** ..... 121
Agency—Foote, Cone & Belding
**HUNTER MANUFACTURING COMPANY** ..... 117
Agency—Meermans, Inc.
**HYDRO-AIRE INC.** ..... 3
Agency—Gaynor, Colman, Prentis & Varley, Inc.

**INTERNATIONAL NICKEL COMPANY, INC., THE** 154
Agency—Marschalk & Pratt Company, Div. McCann Erickson Inc.

**JOHNS HOPKINS UNIVERSITY OPERATIONS RESEARCH OFFICE** ..... 86
Agency—N. Belmont Ver Standig

**KAMAN AIRCRAFT CORPORATION** ..... 104-105
Agency—Charles Palm & Company, Inc.
**KEARFOTT COMPANY, INC.** ..... 129
Agency—E. M. Freystadt Associates, Inc.
**KEUFFEL & ESSER CO.** ..... 83
Agency—J. M. Mathes Adv.

**LAND AIR INC.** ..... 140
Agency—The Admaster Assoc.
**LINDE COMPANY—DIV. UNION CARBIDE & CARBON CORPORATION** ..... 58
Agency—J. M. Mathes, Inc.
**LITTON INDUSTRIES** ..... 13
Agency—Calkins & Holden Inc.

**MARCONI WIRELESS TELEGRAPH COMPANY, LTD.** ..... 42
Agency—Lovell & Rupert Curtis Ltd.
**MINNEAPOLIS HONEYWELL REGULATOR COMPANY** ..... 56
Agency—Foote, Cone & Belding
**MONADNOCK MILLS DIV., UNITED-CARR FASTENER CORPORATION** ..... 12
Agency—H. P. Humphrey—Alley & Richards, Inc.
**MUELLER BRASS COMPANY** ..... 59
Agency—Price, Tanner & Willox, Inc.
**NICHOLS COMPANY, W. H.** ..... 67
Agency—Shattuck, Clifford & McMillan, Inc.

**NORDEN-KETAY CORPORATION** ..... 87-93
Agency—The Haydon Company, Inc.

**PACIFIC DIVISION—BENDIX AVIATION CORPORATION** ..... 143
Agency—The Shaw Company Adv.
**PACIFIC SCIENTIFIC COMPANY** ..... 119
Agency—The Martin R. Klitten Company
**PARKER AIRCRAFT CO.** ..... 10
Agency—Lester-Voorhees Co.

**RAYTHEON MANUFACTURING COMPANY** ..... 138
Agency—Donahue & Coe, Inc.
**REACTION MOTORS, INC.** ..... 139
Agency—Doyle, Kitchen & McCormick, Inc.
**REM CRU TITANIUM, INC.** ..... 22
Agency—The G. M. Basford Company
**REYNOLDS METALS COMPANY** ..... 4th Cover
Agency—Clinton E. Frank, Inc.
**RHEEM MANUFACTURING COMPANY** ..... 2nd Cover
Agency—Getz & Sandberg, Inc.
**ROHR AIRCRAFT CORPORATION** ..... 158
Agency—Barnes Chase Company
**RYAN AERONAUTICAL COMPANY** ..... 159
Agency—Batten, Barton, Durstine & Osborn, Inc.

**SANBORN COMPANY** ..... 62
Agency—Culver Adv., Inc.
**SANDERS ASSOC. INC.** ..... 96-97
Agency—Shattuck Clifford & McMillan Inc.
**SARGENT ENGINEERING CORPORATION** ..... 4
Agency—Darwin H. Clark Company

**SENSENICH CORPORATION** ..... 117
Agency—Fultz Weisinger, Inc.
**SHELL OIL COMPANY** ..... 112-113
Agency—J. Walter Thompson Company
**SINCLAIR REFINING COMPANY** ..... 136
Agency—Morey, Humm & Warwick Inc.
**SPRAGUE ELECTRIC COMPANY** ..... 124
Agency—The Harry P. Bridge Company
**STANDARD OIL COMPANY OF CALIFORNIA** ..... 142
Agency—Batten, Barton, Durstine & Osborn, Inc.
**STROMBERG-CARLSON, DIV. OF GENERAL DYNAMICS CORPORATION** ..... 118
Agency—The Buntrill Company, Inc.
**STURTEVANT COMPANY P. A.** ..... 99
Agency—Ross Llewellyn Inc.

**TECHNICAL DEVELOPMENT CO.** ..... 149
Agency—Willard G. Myers Adv.
**THERMO ELECTRIC COMPANY, INC.** ..... 99
Agency—Fred Lange Associates, Inc.
**THOMPSON PRODUCTS, INC., JET DIVISION** 126-127
Agency—Meldrum & Fewsmith, Inc.
**TIMKEN ROLLER BEARING COMPANY** ..... 15
Agency—Batten, Barton, Durstine & Osborn, Inc.
**TOMKINS-JOHNSON COMPANY** ..... 123
Agency—Besson-Reichert, Inc.
**TOWNSEND COMPANY** ..... 72-73
Agency—Bond & Starr, Inc.
**TRANS-SONIC INC.** ..... 5
Agency—Technical Marketing Associates, Inc.
**TRANS WORLD AIRLINES, INC.** ..... 46
Agency—Foote, Cone & Belding
**TRUE-TRACE SALES CORP.** ..... 115
Agency—Western Adv. Inc.
**TYRON INC.** ..... 63
Agency—Shattuck, Clifford & McMillan, Inc.

**VERTOL HELICOPTER CORPORATION** ..... 147
Agency—Gaynor, Colman, Prentis & Varley, Inc.
**VICKERS, INC. DIVISION OF SPERRY RAND CORPORATION** ..... 108
Agency—Witte & Burden Adv.

**WALDORF INSTRUMENT CO., F. C. HUYCK & SONS DIV.** ..... 64
Agency—A. Hensing Adv.
**WEATHERHEAD CO., THE AVIATION DIV.** ..... 14
Agency—Chamberlin Junk Adv. Inc.
**WESTERN GEAR CORPORATION** ..... 18
Agency—Ruthrauff & Ryan, Inc.
**WESTERN PNEUMATIC TUBE COMPANY** ..... 40
Agency—Western Agency, Inc.
**WESTINGHOUSE ELECTRIC CORPORATION** 80-81
Agency—Fuller & Smith & Ross, Inc.
**WESTON HYDRAULICS—DIV. BORG-WAGNER CORPORATION** ..... 78
Agency—Anderson McConnell Adv.
**WHITE DENTAL MFG. COMPANY, THE S. S.** ..... 136
Agency—Hazard Adv. Company, Inc.
**WHITTAKER COMPANY, LTD., W. R.** ..... 160-161
Agency—Muge-Privet, Inc.

**ZIPPER TUBING CO.** ..... 82
Agency—Western Ads Inc.
**ZENITH PLASTICS CO.** ..... 144
Agency—B B D & O Inc.


## CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.


**EMPLOYMENT OPPORTUNITIES** ..... 162-169
**EQUIPMENT**
For Sale ..... 169-172


## ADVERTISERS INDEX


Air Carrier Engine Service Inc. ..... 171
Atlantic Aviation Corp. ..... 171
Bailey Co., George H. ..... 172
Beech Aircraft Corp. ..... 166
Black Clawson Co., The ..... 172
Burroughs Corp., Research Center ..... 165
Cessna Aircraft Co. ..... 162, 164
Collins Engineering Co. ..... 172
Colonial Aircraft Corp. ..... 171
Engine Works ..... 171
Farrar Aviation ..... 171
Fidelity Personnel Service ..... 162
Flying Tiger Line, The ..... 171
General Electric Co. ..... 162, 164, 167, 170
Goodyear Aircraft Corp. ..... 163
Goodyear Atomic Corp. ..... 167
Link Aviation Inc. ..... 166
Magnavox Co. ..... 164
McDonnell Aircraft Corp. ..... 160
Minnesota Airmotive ..... 170
Navco ..... 47
Norton Air Force Base ..... 168
PacAero Engineering Corp. ..... 171
Pacific Airmotive Corp. ..... 171
Page Airways Inc. ..... 172
Radio & Electronics Supply ..... 171
Rexmert Werner Inc. ..... 172
Skymotive Inc. ..... 170
Smith Aircraft Inc., L. B. ..... 170, 171
Steward-Davis Inc. ..... 170
Trade-Aver Co. ..... 172
Weld Associates, William C. ..... 171

# LETTERS

## ALTA Appreciative

On behalf of Mr. Nick Bez, chairman of the board of ALTA (Association of Local and Territorial Airlines), the individual carrier members, and myself, personally, as general counsel, I thank you and your staff for constructive coverage of the legislation birth and maturity of S. 2229, the Guaranteed Loan Bill.

The member airlines of ALTA gave their all in supporting the CAB-sponsored measure and the detailed coverage given all phases of the legislative history by Transport Editors L. L. Doty and Ford Eastman, was a constant source of strength.

Once again, thanks!

Joseph P. Adams
Assn. of Local and Territorial Airlines
Washington, D. C.

## Army Economy Praised

Just finished reading your article "Army Begins Cost Cutting Program Based On 1,000 Hr. Test Results" (Sept. 9, p. 52), by Mr. J. S. Butz, Jr.

I read this article with great interest since I am an Aircraft Maintenance Technician (Civ USAF), and a potential helicopter pilot and maintenance officer. I must say this is a well written article and very enlightening toward the problems encountered in the field of aviation when new equipment is put into service.

I highly recommend that all personnel concerned with Army Aviation review Mr. Butz's fine article. I further recommend that Mr. Taxpayer do the same, in order that he, too, may know our tax dollars are being well utilized by the U. S. Army Aviation program.

A salute to the TATSA for their important and outstanding test performance with the H-37A helicopter. Also, a salute to a deserving reporter—Mr. Butz.

Horace M. Miller
WOJG, U. S. Army Reserve
375th Trans Term Comd "B"
Mobile, Ala.

## Scores ATC System

Concerning the "Handwriting in the Air" by Mr. Mirzaoff (AW July 15, p. 138)—his basic ideas have general merit, but his knowledge of current practicality and past history of the ATC system has a few glaring inaccuracies.

Air carriers may not wish ". . . to risk the safety of passengers and equipment by traversing areas in which . . . fledging pilots are earning their wings." However, the fact is it happens daily. For instance, none of the nine Air Force primary training schools have designated restricted or caution areas; yet most are situated on or very near airways comprising major air routes. These primary trainees are using T-28s, the cruising speed of which approaches that of the Convair.

Mr. Mirzaoff may not consider the difference between 1 hr. 45 min. and 1 hr. 55 min. in Los Angeles to Phoenix airline schedules a matter of public interest. Evidently he is unaware of how many general aviation aircraft travel at half airline speeds or less and have only four hours cruising range or less.

Flight time of 3 hr. 30 min. may be a safe VFR operation, while 3 hr. 50 min. forces a fuel landing and adds at least 50 min. to the trip, not just 10 or 20 min.

CAA has no ceiling on altitudes to which it will control jet or other traffic. My understanding is that separation is afforded all flights operating within control areas; even direct flights are afforded separation for those portions which cross or overlap controlled airways. The only raising of the control ceiling concerns the "white" areas formerly completely uncontrolled. CAA is establishing as first step, control of the entire continental airspace at altitudes of 24,000 ft. and above. It is this plan which has made the reserved airspace problem assume such huge proportions. This step, incidentally, will benefit military traffic the most, since only a handful of airline transcontinental flights get to 24,000 ft. Altitudes above 25,000 ft. are prohibited to air carriers.

The Grand Canyon episode was most certainly not ". . . an inevitable climax to the attempt to 'control' modern air traffic with a system designed for the DC-3. . . ." Quite obviously no attempt at all is made to control traffic which elects routes outside the protection of controlled airspace; the official accident report makes quite clear the point that ATC assumed no responsibility for control or furnishing traffic advisory information at the point of the accident.

While it is true we needed more radar yesterday and that there may have been some foot dragging in government due to appropriations, safety, and other factors which have retarded its early adoption, we must acknowledge these facts: CAA has been working steadily with radar at Washington National for over 10 years, which, incidentally, is approximately half the life of the entire ATC system. Within the last five years most major terminal areas have added surveillance radar and several military RAPCON's have been brought into the picture for control of traffic in some areas.

However, it is most unfortunate that so many people see fit to take pot shots at strip postings. Apparently they are still quite important and no really practical replacement for them is yet in production. While ATC has occasionally made some mistakes, they have yet to be directly responsible for their first fatality.

ATC seems to be getting more like that slogan about the weather—everybody talking, no one doing. The least we can do is to patiently try to learn what the controller's problems are and then try to help him out. No one has any more direct and practical knowledge of what these problems are than the working controllers—so, please, let's don't throw brickbats at them. If they sometimes seem to view new panaceas for their problem with a jaundiced eye, it is only because so many unworkable ideas have come through the mill.

T. C. Ritchie
Seattle, Wash.

***Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address Letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.***

## No Recollection

We feel that we must comment on Howard L. Moxham's letter "Sabre Echoes" (p. 118) in your Sept. 2 issue.

It is interesting to note Mr. Moxham's keen interest and knowledge concerning the B-58.

He is clearly an advocate of very large words and very small facts.

We cannot seem to recall an outstanding NAA jet bomber put into production. It is a fact the B-45 did not become the world's fastest jet bomber.

The monstrosity hanging from the B-58 only makes it the most versatile bomber being developed. You will note that these so-called monstrosities or similar stores are being carried by all the new *modern* bombers.

We will look forward to the westward leaning building caused by the A3J. It needs straightening from the East wind made by the B-58 (with monstrosity) flying faster than any bomber thus far.

J. V. Gibson
Startled Convair-Ft. Worth Engineer
Valparaiso, Fla.

## World Stopper

Re H. L. Moxham's "Sabre Echoes" letter (AW Sept. 2, p. 118), tell Mr. Moxham that if he will stop the world the rest of us aviation workers will just get off.

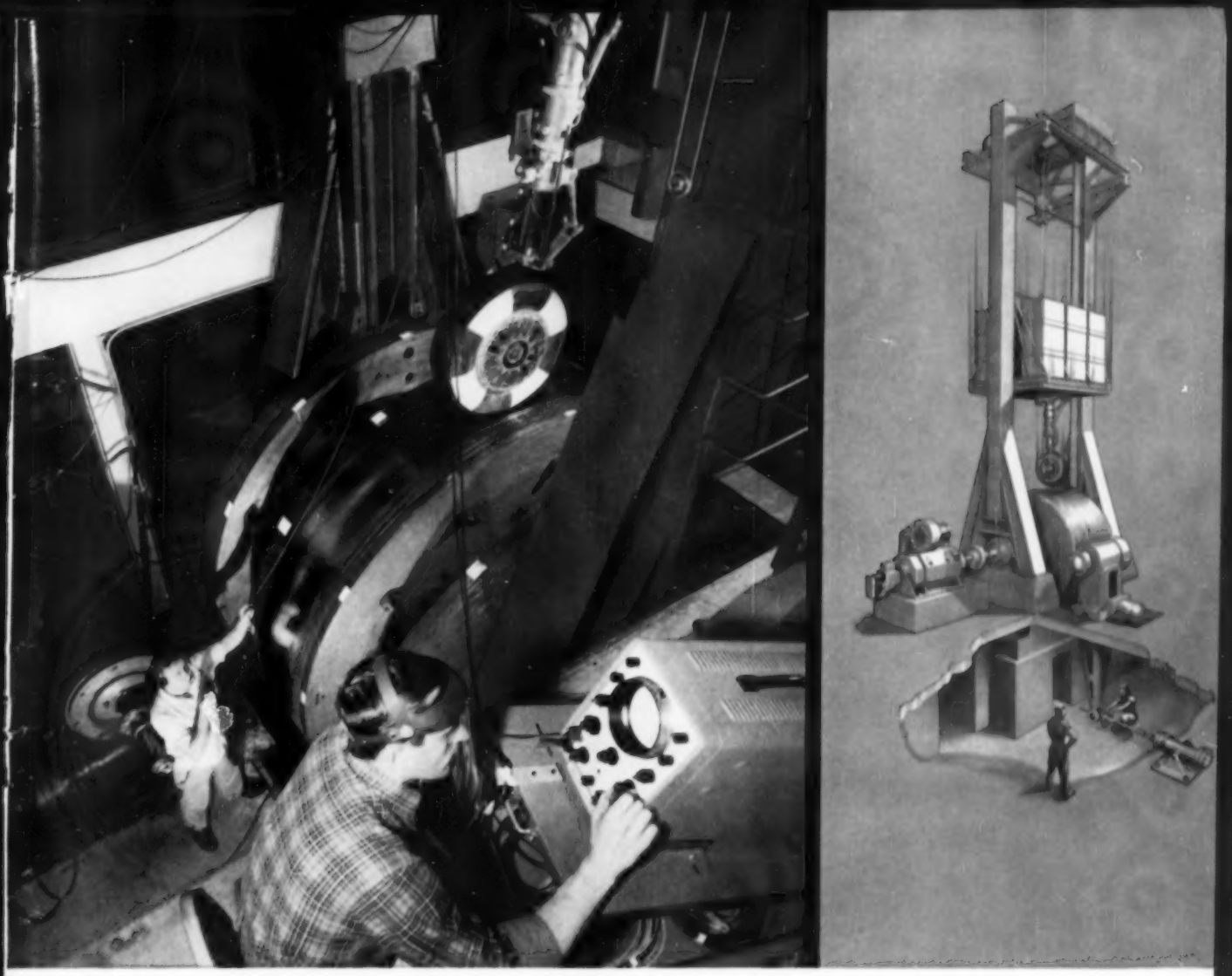
E. G. List, Jr.
Altadena, Calif.

## A4D Forgings

I enjoyed Mr. Stone's article on the Douglas A4D Skyhawk (AW Aug. 26) very much as I was working in the Equipment Section of Engineering at Douglas El Segundo when the first Skyhawk was built. However, he made one mistake that I believe should be corrected for the record.

On p. 53 he states that forgings were not used on the A4D. I'm sure he meant to say that "castings were not used because of their strength weight ratio." In the next paragraph Mr. Stone says that the nose is secured with two latches. If he would examine these latches on the production airplane he would find two forgings. I know, because I designed the forgings to replace the machined latches on the first experimental A4Ds.

Roy P Gibbens
Engineering Department
L. B. Smith Aircraft
Miami International Airport
Miami, Fla.



Giant landing gear test facility is 60 feet high. It simulates conditions that heavy, high-speed planes actually meet.

# BENDIX SHOOTS LANDINGS INDOORS TO HELP PRODUCE BETTER LANDING GEAR SYSTEMS

When designing and producing complete landing gear systems it is vitally important to know in advance just how every component part will respond to the stresses and strains of flight conditions.

That's why the giant landing gear testing equipment pictured above plays such an important part in the development and production of Bendix* complete landing gear systems.

All major components that make up the system such as control valves, nose wheel steering, retractor actuators, power braking as well as wheels, brakes, shock absorbing struts and even tires are subjected to repeated tests of braking, dropping, twisting and vibration before final approval.

For Bendix has proven over many years that landing gear components that have been designed, engineered and tested to work together give better and more dependable performance than any arbitrary assembly system.

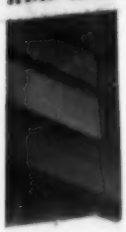
So, when it comes to gear for landing, think and plan in terms of a complete landing gear system. Then, we suggest you think of Bendix and Bendix Products Division at South Bend, Indiana.

*REG. U. S. PAT. OFF.

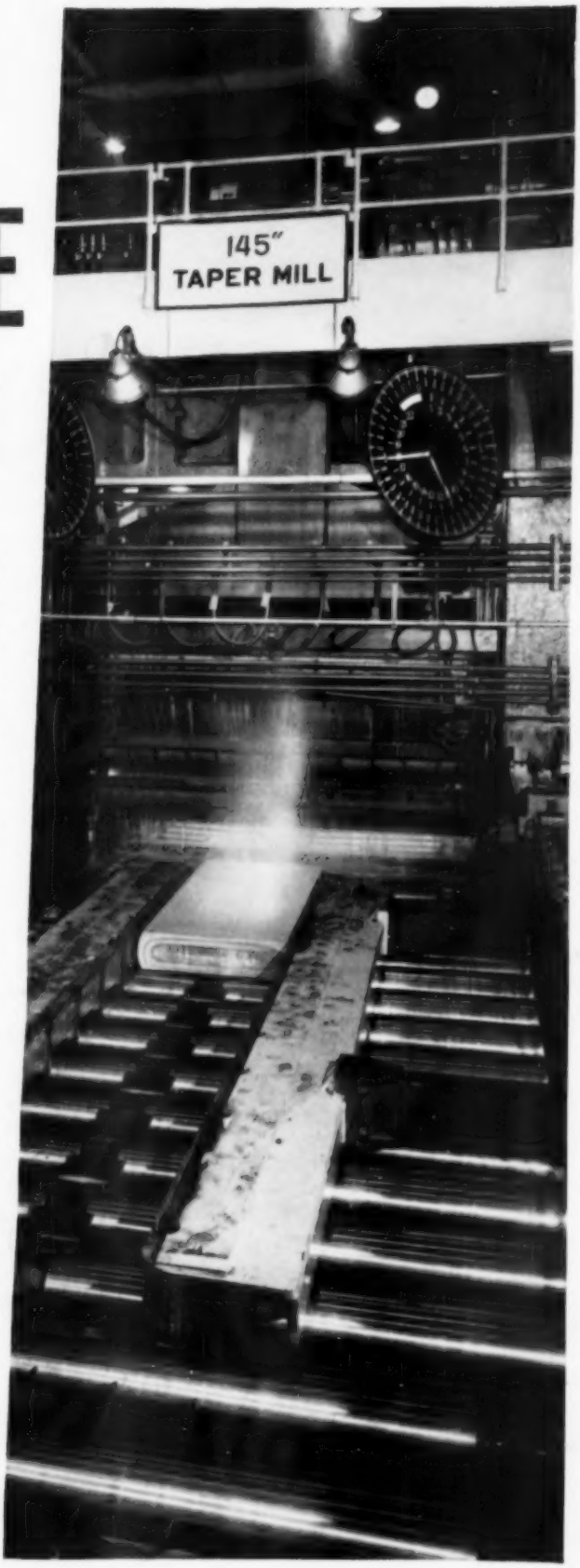
Bendix PRODUCTS DIVISION South Bend, IND.

Bendix AVIATION CORPORATION

E B POWER GS H
UNIVERSITY MICROFILM INC
313 N 1ST ST
ANN ARBOR MICH * C



# King-Size Mill for KING-SIZE SAVINGS




The 145" taper mill shown here, in Reynolds McCook, Ill. plant, is one of the largest in the nonferrous field —and it rolls out some important savings for aircraft manufacturers.

Roll tapered aluminum sheet and plate from this mill saves manufacturers machining time and labor. It saves shipping costs by reducing the handling of unneeded metal. Most important of all, it makes possible substantial savings in weight.

While it can roll constant gauge sheet and plate, this gigantic rolling mill has been specifically designed to roll the tapers dictated by the demands of modern aircraft design—straight tapers, partial tapers or step tapers. A typical specification for straight tapered plate is: Alclad 7075 T6, .090" tapering to .160" x 100" wide x 250" long.

Reynolds can roll the widest, longest aluminum plate . . . can machine it, taper it, stretch it, and sculpture it to your specifications. Make Reynolds your major source for high-quality aircraft sheet and plate.

Write for details on Reynolds expanded facilities, and for index of Reynolds technical handbooks and films. *Reynolds Metals Company, P.O. Box 1800-TJ, Louisville 1, Ky.*

The Finest Products Made with Aluminum are made with REYNOLDS ALUMINUM

*Watch Reynolds All-Family Television Program "DISNEYLAND", ABC-TV.*